



# **INTERNATIONAL JOURNAL FOR INNOVATION EDUCATION AND RESEARCH**

**ONLINE ISSN: 2411-2933 PRINT - ISSN: 2411-3123**



**INTERNATIONAL EDUCATIVE RESEARCH FOUNDATION  
AND PUBLISHER (IERFP)**

**Volume- 9 Number- 1**

**January Edition**

## **About the Journal**

**Name: International Journal for Innovation Education and Research**

**Publisher: Shubash Biswas**

International Journal for Innovation Education and Research  
44/1 Kallyanpur Main road  
Mirpur, Dhaka 1207  
Bangladesh.  
Tel: +8801827488077

**Copyright:** The journal or any part thereof may be reproduced for academic and research purposes with an appropriate acknowledgment and a copy of the publication sent to the editor. Written permission of the editor is required when the intended reproduction is for commercial purposes. All opinions, information's and data published in the articles are an overall responsibility to the author(s). The editorial board does not accept any responsibility for the views expressed in the paper.

**Edition: January 2021**

**Publication fee: \$100 and overseas.**

## Editorial

### Dear authors, reviewers, and readers

It has been a month since I was given the privilege to serve as the Chief Editor of the International Journal for Innovation Education and Research (IJIER). It is a great pleasure for me to shoulder this duty and to welcome you to **THE VOL-9, ISSUE-01 of IJIER** which is scheduled to be published on **1<sup>st</sup> January 2021**.

International Journal for Innovation Education and Research (IJIER) is an open access, peer-reviewed and refereed multidisciplinary journal which is published by the International Educative Research Foundation and Publisher (IERFP). IJIER aims to promote academic interchange and attempts to sustain a closer cooperation among academics, researchers, policy makers and practitioners from a wide range of disciplines, which contribute to state of the art in science, education, and humanities. It provides a forum for the exchange of information in the fields mentioned above by welcoming original research papers, survey papers, and work-in-progress reports on promising developments, case studies, and best practice papers. The journal will continue to publish high-quality papers and will also ensure that the published papers achieve broad international credibility.

The Chief Editor, appointed by the Associate Editors and the Editorial Board, is in charge for every task for publication and other editorial issues related to the Journal. All submitted manuscripts are first screened by the editorial board. Those papers judged by the editors to be of insufficient general interest or otherwise inappropriate are rejected promptly without external review. Those papers that seem most likely to meet our editorial criteria are sent to experts for formal review, typically to one reviewer, but sometimes more if special advice is needed. The chief editor and the editors then make a decision based on the reviewers' advice.

We wish to encourage more contributions from the scientific community to ensure a continued success of the journal. We also welcome comments and suggestions that could improve the quality of the journal.

I would like to express my gratitude to all members of the editorial board for their courageous attempt, to authors and readers who have supported the journal and to those who are going to be with us on our journey to the journal to the higher level.

Thanks,

**Dr Eleni Griva**

Ass. Professor of Applied Linguistics

Department of Primary Education

University of Western Macedonia- Greece

Email: [chiefeditor@ijier.net](mailto:chiefeditor@ijier.net)

## Table of content

Paper ID	Title	Page
2775	<b>Revisiting Socio- economic impact of Villagization, In the Case Assosa Zone, Ethiopia</b> <i>Authors: Tadele Tesfaye Labiso</i>	01-11
2776	<b>An Exploratory Study on the Reverse Innovation Of Tata Nano Motors</b> <i>Authors: Bridget Chipanje, Doing Doing</i>	12-18
2814	<b>University Social Responsibility and The Control Mechanisms of The Ministry of Education from A Systemic View</b> <i>Authors: Mirlene Rabelo Magalhães Dias, Maurício Wilker de Azevedo Barreto, Cinara da Silva Cardoso, João Fernandes Neto, Randal Martins Pompeu; David Barbosa de Alencar</i>	19-35
2833	<b>Digital Testing During the Pandemic Crisis University Students' Opinions on Computer-based Tests</b> <i>Authors: Jana Jaskova</i>	36-53
2868	<b>The Context of The Inclusion of Children with Autistic Spectrum Disorder in Early Childhood Education</b> <i>Authors: Thelma Helena Costa Chahini, Isaac Pereira Viana</i>	54-65
2869	<b>Use of wood waste from Amazonian tree species for the manufacture of products with regional identity</b> <i>Authors: Geislayne Mendonça Silva, Claudete Catanhede do Nascimento</i>	66-76
2872	<b>Historical Evolution of the Conceptual Practice Sustainability Terminology</b> <i>Authors: Fátima Terezinha Silva Santos, Nilzo Ivo Ladwig, Juliano Bitencourt Campos, Vilson Menegon Bristot, Jori Ramos Pereira</i>	77-88
2874	<b>The Sustainable Transport System at the Federal University of Amazonas</b> <i>Authors: Willian Haxwell</i>	89-98
2877	<b>Inclusion, physical activity and quality of life for people with disabilities</b> <i>Authors: Luis Henrique Almeida Castro, Diego Bezerra de Souza, Fernanda Viana de Carvalho Moreto, Nelson Thiago Andrade Ferreira, Juliana Vicente de Souza, Aline Ortega Soloaga, Raquel Borges de Barros Primo, Geanlucas Mendes Monteiro, Ygor Thiago Cerqueira de Paula, Vanessa de Souza Ferraz, Júlia Arruda de Fonseca Palmiere, Cristiane Martins Viegas de Oliveira</i>	99-110
2878	<b>General Gymnastics and its Applicability in the School and Social Environment A Bibliographic Review</b> <i>Authors: Luis Henrique Almeida Castro, Diego Bezerra de Souza, Nelson Thiago Andrade Ferreira, Juliana Vicente de Souza, Aline Ortega Soloaga, Raquel Borges de Barros Primo, Geanlucas Mendes Monteiro, Ygor Thiago Cerqueira de Paula, Vanessa de Souza Ferraz, Lúcio Barbosa Neto, Wesley Sebastião da Silva Moraes, Cristiane Martins Viegas de Oliveira</i>	111-118
2881	<b>Mental health and workers in the context of the COVID-19 pandemic: an international literature Survey</b> <i>Authors: Pedro Henrique Conte Gil, Marta Elisete Ventura da Motta, Maria Emília Camargo, Lisarb do Amaral Ribeiro, Tiane Camargo</i>	119-133



2883	<b>Collective Experiences with Heritage tourist events and socializations in the Historic Center of São Luís</b> <i>Authors: Conceição de Maria Belfort de Carvalho, Donny Wallesson dos Santos, Maurício José Morais Costa, Kláutenys Dellene Guedes Cutrim, Arkley Marques Bandeira, Vanderley Rabelo de Jesus</i>	134-145
2884	<b>Freedom and Truth in Public Sphere, and the Contest of Fake News: A Reflection from Kant and Hannah Arendt</b> <i>Authors: Zilmara de Jesus Viana de Carvalho, Matheus Costa e Costa, Rayssa Marchão Araújo, Kamila Fernanda Barbosa Sampaio, Flávio Luiz de Castro Freitas</i>	146-158
2885	<b>Artistic Occupations in the Historical Center of São Luís (Maranhão) implications for the preservation and valorization of the cultural heritage of Maranhão</b> <i>Authors: Conceição de Maria Belfort de Carvalho, Donny Wallesson dos Santos, Maurício José Morais Costa, Kláutenys Dellene Guedes Cutrim, Arkley Marques Bandeira, Vanderley Rabelo de Jesus</i>	159-171
2887	<b>Evaluation of the quality of wood from naturally fallen tree for the development of products in Design</b> <i>Authors: Jéssica Ester Elvas Costa, Claudete Catanhede do Nascimento, Roberto Daniel de Araújo, Karla Mazarelo Maciel Pacheco</i>	172-187
2888	<b>Teaching practice for pandemic times and the empowerment of audiovisual didactic sequences</b> <i>Authors: Carina Dias da Silva Rodrigues, Andréia dos Santos Sachete, Fábio Rossi</i>	188-204
2891	<b>Pandemic and Education: notes from the Brazilian context</b> <i>Authors: Lucas Pacheco Brum, Marcus Vinícius Silva Magalhães, Cristina Rolim Wolffenbüttel, Carlos Augusto Pinheiro Souto, Maria Cecília Lorea Leite</i>	205-219
2892	<b>TEACHING HISTORY AND INDIGENOUS CULTURES IN BASIC SCHOOL EDUCATION REFLECTIONS FROM FIELD RESEARCH</b> <i>Authors: RICARDO JOSE LIMA BEZERRA, Tatiane Lima de Almeida</i>	220-229
2893	<b>Exploring University Students' Perceptions of Plagiarism: A Focus Group Study</b> <i>Authors: Lokesh Ramnath Maharajh</i>	230-245
2894	<b>Action Research in the Methodological Process of the Triangular Approach and in the Stop Motion Technological Process</b> <i>Authors: Maria Aparecida Santana Camargo, Vivian Cristina Belter Lunardi</i>	246-258
2895	<b>Discourse Analysis on Physical Activity for People with Disabilities</b> <i>Authors: Leandro Rachel Arguello, Cristiane Martins Viegas de Oliveira, Diego Bezerra de Souza, Antonio Carlos Dorsa, Raphael Ricardo de Jesus Portela, Aline Ortega Soloaga, Raquel Borges de Barros Primo, Geanlucas Mendes Monteiro, Flávio Henrique Souza de Araújo, Dayane Caetano, Tayla Borges Lino, Juliana Vicente de Souza</i>	259-273
2896	<b>The ANALYZING THE APPLICATION OF THE EQUALITY CONCEPT TO INDIGENOUS STATUS IN RELATION TO HUMAN RIGHTS</b> <i>Authors: Cristiane Martins Viegas de Oliveira, Leandro Arguello, Diego Bezerra de Souza, Antonio Carlos Dorsa, Raphael Ricardo de Jesus Portela, Aline Ortega Soloaga, Raquel Borges de Barros Primo, Geanlucas Mendes Monteiro, Flávio Henrique Souza de Araújo, André Luiz Dias, João Vitor Alves dos Santos, Gildiney Penaves de Alencar</i>	274-288

2898	<b>Torrefaction as a Pre-Treatment of Biomass: A Bibliometric Analysis</b> <i>Authors: José Airton de Mattos Carneiro-Junior, Eduardo Oliveira Teles, Fabio Matos Fernandes, Carine Tondo Alves, Silvio Alexandre Beisl Vieira de Melo, Ednildo Andrade Torres</i>	289-313
2902	<b>Evaluation of Equity-linked structured products and pricing</b> <i>Authors: Chaitali Kotadia</i>	314-335
2905	<b>Biometric and reproductive characteristics of the King Tiger Plecos Hypancistrus sp. "L-333" (Siluriformes: Loricariidae) endemic to the lower Xingu River (Pará, Brasil)</b> <i>Authors: Fabrício Barros de Sousa, Hélio Beltrão, Rodrigo Yudi Fujimoto, Raimundo Aderson Lobão de Souza, Severino Adriano de Oliveira Lima, Raniere Garcez Sousa</i>	336-352
2909	<b>The Operational Sustainability of the Firm: The operational performance versus financial solvency binomial – OPFS</b> <i>Authors: Jose Antonio De França, Nathália Alves Carvalho, Clésia Camilo Pereira, Eduardo Tadeu Vieira</i>	353-370
2910	<b>Patent Profile of the Patent Deposits of FINEP Participants with CT-Petro Resources</b> <i>Authors: Rosa Elaine Andrade Santos, Gilberto Andrade dos Santos, Gabriel Francisco da Silva, Suzana Leitão Russo</i>	371-381
2912	<b>Shattering Ethnocentric and Eurocentric Subjectivities in foreign language teaching: A Critical Intercultural Perspective</b> <i>Authors: Adriana Carolina Torres Escobar</i>	382-395
2813	<b>A NUTRITION VIEW OF COVID 19 IN THE PANDEMIC</b> <i>Authors: Ana Lúcia Alves Caram, Gracinalda de Oliveira Silveira, Edna Cristina Mariano de Lima, Anna Christina Aires Braga Carneiro, Josiane Ferreira de Mello, Eliana Setsuko Kamimura, Mônica Roberta Mazalli, Thelma Fernandes Feltrin Rodrigues, Ana Raquel Medeiros Beck, Rafael Resende Maldonado</i>	396-409
2914	<b>Bibliographic prospecting for dryeration process system evaluation in the face of the conventional grain drying</b> <i>Authors: Jose Roberto Rasi, Mario Mollo Neto, Roberto Bernardo</i>	410-424
2914	<b>Ten golden lessons from Republic of China (Taiwan), the best country to save lives during 300 days battle against Covid-19</b> <i>Authors: Jonas Gomes da Silva</i>	425-474
2916	<b>Project Model Canvas' Contributions to the Project-Based Learning Method</b> <i>Authors: Francisca Janaina Dantas Galvão Ozório, Petrônio Cavalcante, Ana Lucia Ferreira Pitombeira, Geraldo Venceslau de Lima Junior, Sinara Mota Neves de Almeida, Emanuel Rodrigues Almeida, Andrea Moura da Costa Souza, Igor de Moraes Paim</i>	475-484
2918	<b>Pereskia aculeata vibrational model by Raman characterization and DFT method</b> <i>Authors: Quesle Martins, Natali Felix Arinos, Cristian Aguirre, Jorge Brito de Faria</i>	485-505
2920	<b>8958 1 Dimensions for the Non-Financial Indicators Metric for Production Chains</b> <i>Authors: Margarete Arbuseri, Maria Emilia Camargo, Antonio Jorge Fernandes, Maria Elisabeth Pereira, Isadora Arbuseri Menegotto</i>	506-516
2925	<b>INLET CROSSING INSPECTION IN URBAN WAY BASED ON ROAD SAFETY FACTORS.</b> <i>Authors: Irauna Maicon Rodrigues de Carvalho, Luiz Mauro Brandolt, Átila Sielskis Vieira Ermes, Juliana Christine da Silva Granja</i>	517-526

<b>2926</b>	<b>Diagnosis of hollow trees in an area of effective sustainable forest management in the Amazon forest</b> <i>Authors: Suzana Helen da Silva Medeiros, Claudete Catanhede do Nascimento, Bruno Rodrigues Oliveira, Marcos Antonio Silva de Souza, Fernanda Barbosa Barros</i>	<b>527-539</b>
<b>2928</b>	<b>Production strategy influence on the economic viability of a family fish farm in Pará state, Amazon, Brazil</b> <i>Authors: Marcos Ferreira Brabo, Gerefson Almeida da Silva, Daniel Abreu Vasconcelos Campelo, Galileu Crovatto Veras, Andréia Santana Bezerra, Marcos Antônio Souza Santos</i>	<b>540-549</b>
<b>2929</b>	<b>Profile of peach palm fruit consumers in the Metropolitan Region of Belém, Pará, Brazilian Amazon</b> <i>Authors: Marcos Antônio Souza dos Santos, Daniellen Costa Protázio, Gabriela Pereira da Costa, Fabrício Khoury Rebello, Cyntia Meireles Martins, Andréia Santana Bezerra, Amanda da Silva Nogueira</i>	<b>550-560</b>
<b>2911</b>	<b>Thematic Analysis of Oromo Proverbs Said About Women</b> <i>Authors: Alemitu Oli Aleta</i>	<b>561-573</b>
<b>2906</b>	<b>Academia During The Covid-19 Pandemic: A Study within the Geotechnical Engineering Research Community</b> <i>Authors: Gabrielle Abelskamp, J. Carlos Santamarina</i>	<b>574-587</b>

# ***Revisiting Socio- economic impact of Villagization, In the Case Assosa Zone, Ethiopia***

**Tadele Tesfaye Labiso**

*Address:* tadetesfa91@gmail.com, +251910033591 Wolayta Soddo University  
College of Social Science and Humanities, Department of Geography and Environmental Studies

## **Abstract**

*The overall objective of this study is to explore the practice and challenges of villagization; in the selected woredas of the Assosa zone Beninshangul Gumuz regional state. To achieve goals of the survey study mixed research method was employed. Generally. the Sample size of 168 sample households were determined by using  $S = \frac{X^2NP(1-P)}{d^2 (N-1) + X^2P (1-P)}$ , The research employed exploratory research design on the challenges and implementation of the program, and it applied mainly qualitative methods. On the basis and types of data gathered and the instrument used, both quantitative and qualitative techniques of data analysis or binary logistic regression supported by SPSS was employed. The only good thing about this life was farming since people had fertile lands. But, when villagization was implemented the lives of the villagers improved because they started to have better access to social services. The study showed that villagization was implemented voluntarily and based on the consent of the local people. However, it is possible to conclude that villagization has significantly improved the lives of the villagers by bringing positive changes that did not exist before. people.*

**Key Words:** *villager, relocation, social services, dispersed settlement*

## **INTRODUCTION**

Villagization has been defined "the grouping of the population into centralized planned settlements" (Steingraber, 1987). It is frequently confused with 'resettlement' as the two policies often occur simultaneously and may overlap (Buzuayew et al., 2016).

Villagization programs have been implemented rather frequently in Africa for the last century, with governments promising improved socio-economic standards. The most recent villagization program in Ethiopia is not the first. There have been several programs implemented throughout the years, particularly during the Derg regime (Maria, 2015).

Villagization programs have been highly controversial due to implementation problems, state coercion, and the hidden agenda of the governments (Maria, 2015). All programs have had a significant impact on a large number of people, both directly and indirectly. There is a lot of empirical research on the villagization in various disciplines regarding the actual effects of the programs. Unfortunately, very few studies show evidence of the concept being successful (Guyu, 2016).

The phenomenon of villagization is unusual because it involves many different human rights perspectives, both legal and others. Of particular interest are, of course, all reports of the human rights abuses linked to the execution of the program but also the failure of the states to provide the fundamental rights for the people as promised. Inevitably, this raises questions regarding the validity of villagization programs (Asrat, 2009).

The villagization plan introduced in November 2010 emphasizes on rural development while incentivizing easier access to education and health facilities. Thus, it is seen as a way to facilitate the delivery of services to people living in scattered homesteads that had been harder to reach. The Government plans to villagize 1.5 million people by 2013 in four regions: Gambella, Afar, Ethiopian Somali, and Benishangule-Gumuz (Buzuayew et al., 2016).

The most common official objective for the implementation of villagization programs is the provision of, or improvement of, fundamental economic and social services, such as infrastructure, housing, health care, access to food and water, education, farming facilities, and so on (Buzuayew et al, 2016).

The aims of the villagization are to transform the living condition of pastoral and semi-pastoral communities of these regions sustainably by improving their access to socio-economic services on the principles of voluntarism (Botterli, 2015). BGR is comprised dominantly of semi-pastoral communities, whose livelihood is mainly dependent on both arable and livestock farming, among others. The majority of farm households are living on the most traditional ways of living, a prominent example being the Gumuz, the Berta, the Mao, and the Komo ethnic groups, which are still practicing hunting and gathering activities as well as shifting cultivation in the remotest area of Ethiopia (Guyu, 2012).

In Ethiopia, the need for these schemes is guaranteeing the sustainable food security through guaranteeing the sustainable supply of development vehicles (the socio-economic services and other infrastructures such as road, telephone, and electric power, (NCFSE, 2003; BGRG, 2010).

According to the Benishangul-Gumuz Regional Government's voluntary Villagization Program Plan (2010), the goal of the program is to "provide basic a socio-economic infrastructure" and "ultimately to enable them food secured and to bring socio-economic and cultural transformation of the people (Guyu, 2012).

There is a doubt that the implementation of current villagization is going in line with the principles of VVP, particularly in the Benishangul-Gumuz Region. Empirical shreds of evidences point out that there is a mismatch between the policies of the VVP and ways of implementation at grassroots levels by local authorities (Guyu, 2012).

Of course, its implementation, particularly in BGR, has started since September 2010, and is a part of the Benishangul-Gumuz Regional food security strategy (BGRFSS) designed in 2004. However, there has not been a study on the villagization schemes both at national and regional as well as local scales in Ethiopia. This is the motive for taking up the current research at least in the Assosa zone at BGR in Ethiopia.

As stated in the above paragraph, those challenges had not been assessed by the researchers, particularly in the Assosa zone, to what extent they are affecting the settlers in the study area. Therefore this study, aims to explore the challenges of villagization in BGR to understand how well it has been going on, the

awareness and attitude of villagers towards it, its development indicators, and finally it is policy implications to suggest some possible remedies for the future.

### Research Method

To achieve the general and specific objectives of the study, mixed research method was employed. Quantitative data was collected and analyzed first, followed by the collection and analysis of qualitative data, meaning that qualitative and quantitative data are not combined in the data analysis; instead, integration occurs when the findings are interpreted (Creswell, 2007).

### Research design

The research employed exploratory research design on the challenges and implementation of the program, applied mainly qualitative methods. The survey was used to validate the qualitative findings and to come up with additional numerical information on the necessary socio-economic conditions of the villagers (Creswell, 2007).

### Sources of Data

Both primary and secondary sources of data was used. The primary data-gathering instruments for the research comprised structured interviews, questionnaires, and focus group discussion and observation. Secondary sources of data: written documents used or reviewed to enrich the study.

### Sample Size and Sampling Technique

To make the sample area manageable and representative, from the seven woredas in the Assosa zone ,only four woredas, were included in the sample. Based on this, Assosa, Bambasi, Kurmuk and, Sherkole woredas were selected purposively in line with the severity of the problem.

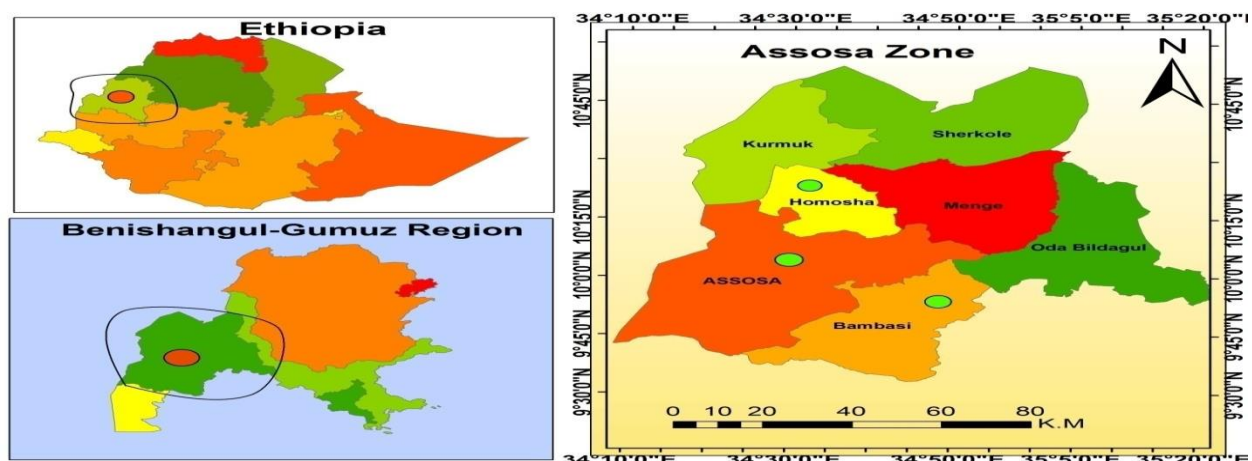


Figure 3.1 Administrative map of the study area

According to population bureau the region (2016), in the sampled Woreda there are around 3,563 male and 665 female total 4,228 settlers. From this 161 male and 64 female total 225 households were selected as a sample of the study using convenience sampling since all samples have the same characteristics. The sample size of the settler respondents for each site was determined by the proportional sampling technique,



and in each location, settler respondents were selected by a simple random sampling technique (Johnson, R. B. ; Turner, L.A.(2003).

Based on the formula suggested by Krejcie & Morgan (1970), sample size of 168 sample households was determined. The method and the calculation were given as follows:

$$S = \frac{X^2 NP}{d^2 (N-1) + X^2 P} (1-P)$$

Where; S = required sample size.

$X^2$  = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be .50 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (0.05).

### **Methods of Data Analysis**

As mixed methods design for data collection, mixed methods of data analysis was employed. The quantitative data collected through a questionnaire survey and qualitative data collected through FGDs, KIIs, and field observations were analyzed in a mixed fashion. The quantitative data was analyzed and presented and then triangulated with qualitative results.

## **RESULT AND DISCUSSION**

### **Personal Characteristics of respondents**

#### **Gender of Respondents**

Since the study's focus is on the practice and challenge of villagization, out of the total of 168 respondents, 34 were women, whereas the rest (n=134) were male respondents. Women, respondents were included to compare, and contrast the reliance resource endowment, access to support services, and other factors which influence the livelihood of rural households between the households, which are run by de facto women heads of households and male-headed households.

#### **Age of Respondents**

The average age of the household head in the study was 40.1 (SD=10.4). The youngest respondent in the study was 18 years old, whereas the oldest respondent was 74 years old. The average age for women respondents were found out to be 39.06 years (SD=9.6), whereas that of men were found to be 44.25 years (SD=12.6).

### **Household Characteristics**

#### **Family Size**

The average family size for the respondent households were found out to be 4.93 (SD=2.27), which is slightly higher than the regional average of 4.7 (CSA, 2007). The minimum family size in the sample respondents were found to be one, whereas the maximum was ten persons. The average family size for de facto women head households were 4.52 (SD=2.01), whereas the average family size for male-headed

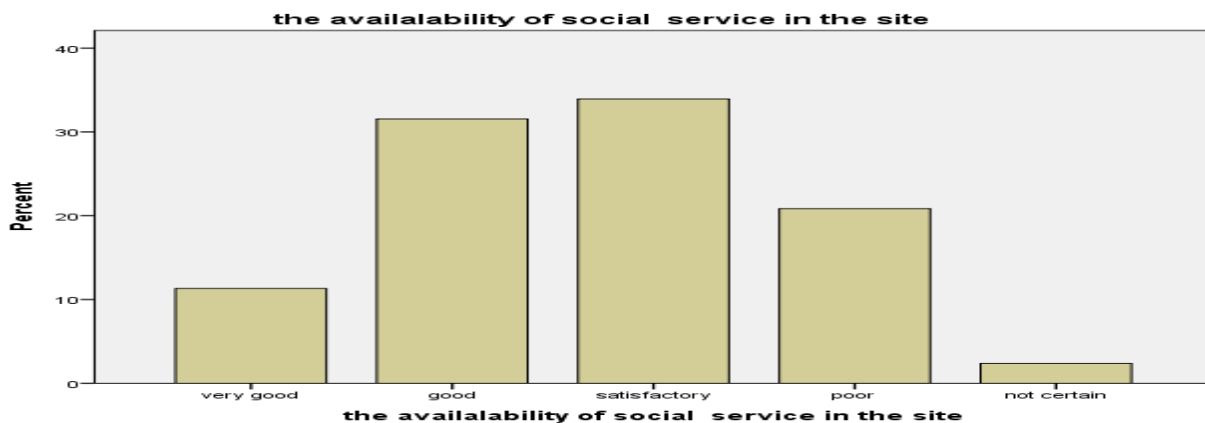
house, were 6.55 (SD=2.26). The age dependency ratio was found to be 1.04 which is higher than the regional figure of 0.95 (Regional Statistic and Population Office 2007).

### Livelihood Strategies

Mixed subsistence farming where the crop and the animal sub-sectors are mutually interdependent is the standard kind of livelihood for all households. All families, however, mentioned that crop production is more important than livestock production to them in terms of immediate food supply and income to the family.

### Improvement in Access to Basic Social Services

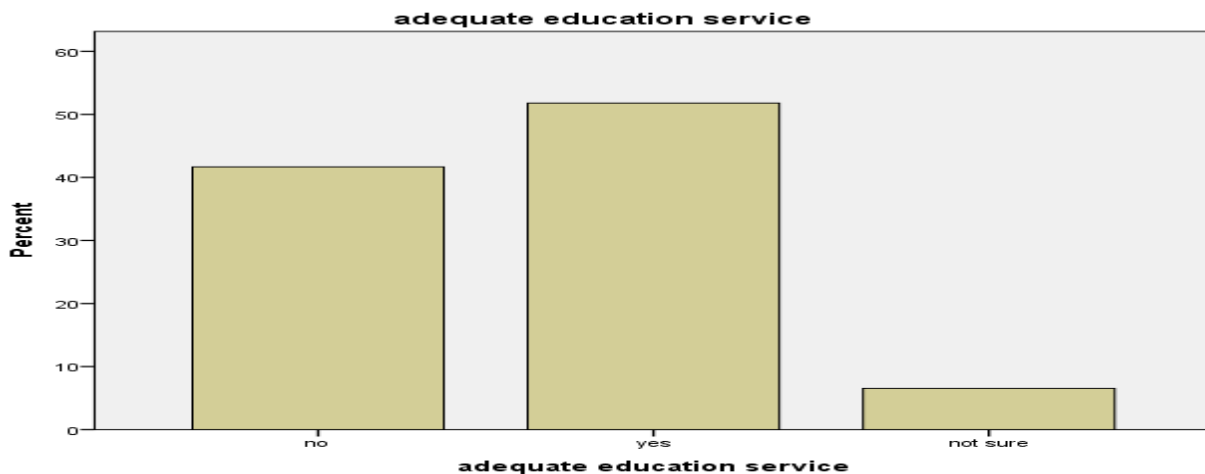
As the informants said, social services already existed prior to the villagization program, but the problem was that people lived far away from them and did not have good access to them. These services were accessible only to those who lived closer to them but difficult to access by those who lived in scattered settlements. Here the bar drawn below shows the variation in the response of participants in relation with the availability of services.



Out of 168 respondents, 19 (11.3%) said, the improvement in access to basic social service was perfect, and 53(31.5) said, the increase in access to basic social service was excellent. Out of 168 respondents, 35(20.8%) said, the growth in access to basic social service was poor.

### Educational Service

Coming to educational service, as the survey result shows, people who previously lacked better access to it began to access the service after their settlement in the villages. Now, education is no longer a problem like before, as schools are close to people. Villagers are also pleased, especially about the fact that children do not have to wait until the age of ten to start school like before. As per the observation, discussion with focus group discussants, there is primary schools in almost all the villages with teachers employed by the government who regularly do their job.



Survey data, 2019

**Mohammed expressed** his view concerning the accessibility of education service as follows:

"I am so happy about the villagization program basically because children are now able to go to school. Going to school was something very hard for children in the past. But now, due to the villagization program and the Settlement of people in villages, schools became closer. For this reason, I am no longer worried because children can now access what was inaccessible to them in the past."

### Health Service

As the above table indicate, out of surveyed 168 sample respondent household, 84(50%) stated the health service provided for them were not adequate as promised for them by Government. Remaining, 71(42.3) of respondent out 168 said the service that provided for them were appropriate and satisfied by what happens in their respective villagization site.

As the survey result shows, the other most crucial thing that happened due to the villagization program is that access to health service has improved. Now, people can get medical treatment whenever sicknesses occur because there is a health Centre as well as health posts in almost all villages which provide services to the people. No one dies anymore because of the distance of health service like before.

### As Ali from wemba site said,

"The fact that health service is now closer to me in the village has brought a huge relief. I now have better access to the service and can access it anytime I feel the need. I believe everyone is happy about this, as well."

As the analyzed document revealed, there are model households in the villages that have received training and have now started to use toilets. In the following village, a total of sixty-six (70) families are current users of toilets. In Wemba village, there are seventy- six (76) households with their bathroom and forty-one (41) in Urura communities. Since the number of people using toilets in the villages has increased, using the surrounding area or open space for the bathroom has been reduced.

**Clean Water, Mills, Transportation and Mobile Networks**

**table 4.8 shows the availability of adequate water supply for domestic use and livestock**

Have get sufficient water supply?	Frequency	Percent	Valid Percent	Cumulative Percent
No	76	45.2	45.2	45.2
Yes	82	48.8	48.8	94.0
not sure	10	6.0	6.0	100.0
Total	168	100.0	100.0	

Out of surveyed 168 sample respondent families, 76(45.2%) stated, the water supply provided for them were not adequate as promised for them by Government. Remaining 82(48.8) of respondent out 168 said the service that provided for them were fair and satisfied by what happens in their respective villagization site.

**Senait from Abrhamo put it like this,**

"What made villagization very good to me is the fact that mill houses are closer. I no longer grind corns with my hands as I did in the past since there is a mill house in the village where I can take my corn and have it ground whenever I want."

**The Movement of People to the Villages**

Moreover, to cross-check the participation of local people in the process of program formulation, and implementation, villagers were interviewed and the followings are the testimonies of villagers about the level of participation.

**Table 4.9 shows the participation of people in the villagization program.**

How did you participate in the program?	Frequency	Percent	Valid Percent	Cumulative Percent
1.voluntarily	167	99.4	99.4	99.4
2.involuntarily	1	.6	.6	100.0
Total	168	100.0	100.0	

As Informants said, after the officials had finished the discussions with the local people and succeeded in convincing them, people from scattered settlements came and settled in the villages. People moved to the towns without being forced by the authorities. Surprisingly, some people started the campaign on their account and settled in the communities without waiting for the scheduled and official date. They did this because they were motivated by the promises made by the Government. They even took the initiative by cutting trees (timbers) for building houses. They were ready to work together with the government to make the implementation of the program useful and successful.

### Significant Challenges of Villagization,

Table 4.10: shows the challenges of villagization program

	Main challenges	Frequency	Per cent	Valid Percent	Cumulative Percent
1	misunderstanding of community	47	28.0	28.0	28.0
2	lack of awareness	47	28.0	28.0	56.0
3	commitment of implementers	27	16.1	16.1	72.0
4	The pressure of host communities	20	11.9	11.9	83.9
5	access to service	27	16.1	16.1	100.0
	Total	168	100.0	100.0	

Survey data (2019)

#### Misunderstanding of community

According to the survey results, 47 (28%) of the household reported that the main challenges implementing the villagization program is a misunderstanding of the community toward it.

Villagization is susceptible to various challenges in terms of implementation and also poses challenges to the well-being of the relocated populations.

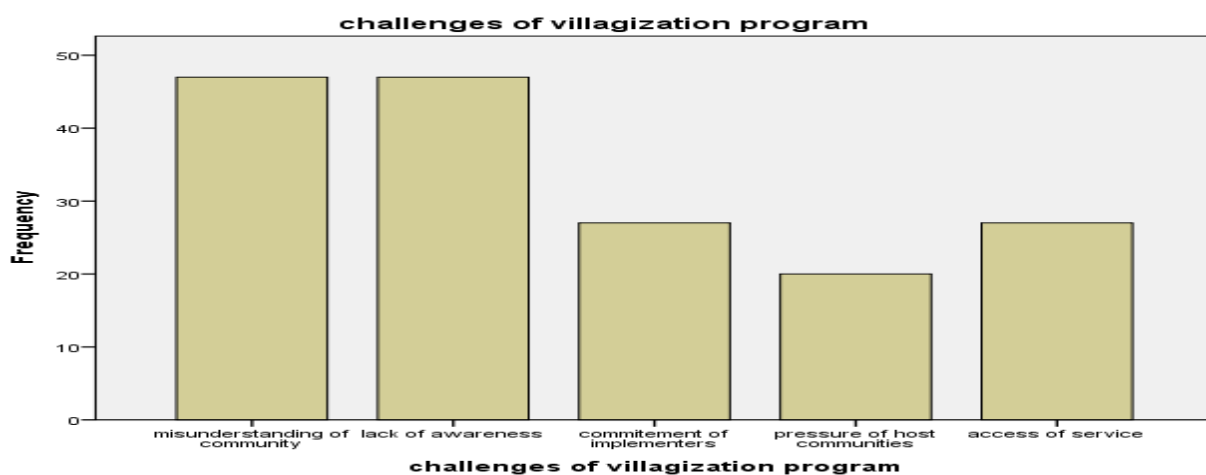
As Lorgen (1990) puts, the problems arising from villagization can be divided into those derived from the way villagization implemented and those arising from the experience of living in the new villages.

According to the survey results indicated in the above table, 47 (28%) of the household reported that there was less awareness creation program held, and even in some development centres, it was absent.

According to informants, concerning the experiences of villagers, challenges usually include the physical location of the villages, especially their distance from the fields, in terms of walking to them and protecting them from vermin and theft, and lack of water and fuelwood.

#### Lack of Awareness

According to the survey results indicated in the above table, 47 (28%) of the household reported that there was less awareness creation program held. The bar chart below depicts the main challenges of the villagization program in the study area.



Many informants argued that there was less awareness creation program held, and even in some development Centre, it was absent.

Similarly, the information generated from focus group discussion held in Bambasi and Sherkole *Woreda* states that, the implementation of the program faced challenges from the settlers. They had no sufficient information related to the intention and importance of villagization program.

### **Inadequate Implementation Performance**

Field data and researchers' observation at various village centers revealed that the construction of residences, schools, feeder roads, and veterinary clinics are on progress. However, the establishment of water points, shops, electric power supply, provision of agricultural inputs, and training centres are the left-back activities. There is gap in the planning and implementation of the social and economic institutions at different development centres. The regional Government appears to have succeeded less in providing the development centers with all the promised essential services.

### **Lack of Clean Water in the village**

Though the program prioritizes clean and sufficient water supply, it persistently encountered problems in identifying potential water points, completion of water projects construction, and purification of surface water.

The study indicates that the implementation performance of water projects was deficient, and the delay of these projects impedes the successful implementation of villagization programs. Some informants and group discussant stated that the absence of water for humans and livestock in some villages resulted in returning settlers to their previous homestead. Researchers' field observation also confirmed that there is a clean water supply problem.

### **Delay of Farmland Distribution**

The study found out that farmland preparation and distributions for farming activity lagged. Communal land ownership system was identified as significant contributing factor for achieving less in farmland preparation and distribution endeavour. Thus, we are face a very severe challenge in preparing and distributing farmland to settlers in many villagization centres.

### **Conclusion**

The study tried to identify the changes and improvements that resulted from the implementation of the villagization program. This study showed that the villagers in all villages had complicated lives and poor living conditions before the villagization program.

Furthermore, women suffered assaults in the hands of their husbands without getting protected. Villagers in the three villages acknowledged farming as the only positive thing about the previous life.

The findings of this study showed villagization implemented to make the lives of the people better by providing essential social services to them. The program aimed at bringing scattered people together to benefit from Government services while living together in villages. The local people were consulted and



informed of things they needed to know. Moreover, various social services were promised to them, although not all the guaranteed services materialized.

Now, it is possible for children can start school at school age because the distance is no longer a problem. No one has to walk a long distance to the health center, mill house, and to fetch water because these services are available at a closer range. Women have particularly benefitted from the availability of these services due to their proximity to them they no longer have to fetch water from far away, grind corns with their hands or walk a long distance to the mill house.

As this study showed, the villagization has improved communication and interaction among the villagers due to their togetherness. People have got to know one another better than before and now identify themselves as members of the same community. If anyone is in trouble and needs help, others can easily hear about it and come to help. There is a sense of harmony and unity among the villagers as a result of the villagization program. The government can also reach the people whenever it wants them because they are together in the villages. People can now work together and solve their problems. Due to their sense of belonging together and the presence of village government, security improved in the villages.

### **Recommendation**

- The findings of this study believed to serve as a basis for future policymaking in the area of population relocation.
- The findings help shape decision making in designing a policy involving population movement and help policymakers set clear standards for a successful and effective implementation of the villagization program.
- Hence, policymakers and implementers should reconsider the villagization program and see it from the target population.
- All the necessary things such as houses, health centers, water pumps, mill houses and schools have to be built first and made ready for use. Farmlands have to be cleared, and distributed to the people as well.
- The movement of people to the villages should take place only after everything essential and indispensable has been made available and ready.
- It also has to be understood that the villagization program should not be implemented unless the basic principles inherent in it are respected.

### **REFERENCES**

- Abiy ,Z., Alemayehu,W., Daniel T., Melese, G., and Yilma, S.,(ed). (2009). Introduction to Research Methods: Preparatory Module for Addis Ababa University Graduate Programs. Ahlbrandt,S. (2005): Learning Lessons from IDP Resettlement: Villagization in northwest Rwanda.
- Asrate, T. (2009): The Dynamics of Resettlement concerning to the Ethiopian Experience, Kimmage Development Studies Centre, Kimmage Manor, Whitehall Road, Dublin 12, Ireland
- Benishangul-Gumuz Regional Government, Villagization Programme Implementation Guideline. (2010, September). Assosa; Translated from the Amharic

- Botterli,A. (2015): Adapting to Climate Change through Villarization? The Context of Sedentary Vulnerability in Afar Region, Norwegian University of Life Sciences, Department of International Environment and Development Studies.
- Buzuayew, H., Eyob, N.,and Habtamu, A.(ed). (2016).Exploring the Challenges and Prospects of Villagization Program in Afar National Regional State, Ethiopia. International Journal of Current Research Vol. 8, Issue 04, pp.30005-30012 April, 2016 .
- Creswell,J. (2007): Qualitative inquiry & research design: Choosing among five approaches (2nd Ed.)
- Dattalo, P. (2008): Determining Sample Size: Balancing Power, Precision, and Practicality. Pocket Guides to Social Work Research Methods: Oxford University Press, New York.
- Guyu, F. (2012): Voluntary Villagization Scheme (VVs); For Transforming Semi Pastoral Communities in Benishangul-Gumuz Region, Northwestern Ethiopia: Challenges and Local Development Indicators, Journal of Sustainable Development in Africa (Volume 14, No.5, 2012).
- Johnson, R. B. & Turner, L.A.(2003): Data collection strategies in mixed method research. Thousand Oaks, CA: Sage Version New Delhi and Singapore.
- Fransen, S., and Kuschminder, K.,(2014).Lessons Learned From Refugee Return Settlement Policies: A Case Study on Burundi's Rural Integrated Villages. Refugee Survey Quarterly, Vol. 33, No. 1, pp. 59–76.
- Mads, H., (2015): A case study of Ethiopia's villagization programme
- Maria,G,. (2015). Is Villagization an Acceptable Solution? Master Thesis, Master Of Laws Programme Higher Education Credits, Faculty of Law Lund University.
- McQueen, R. A. & Knussen, C. (2006). Introduction to Research Methods and Statistics in Psychology.Pearson Education Limited: Harlow Essex UK.
- Mhanda,L.,(2011):Tanzania and the Geopolitics of Rural Development: The Return of Neoliberalism; Journal of Emerging Knowledge on Emerging Markets, Vol. 3 2011,
- Moti, M,. (2014): Politics of Development and Resettlement In Ethiopia: Is It Villagization Or Land Grabbing? Master Thesis, Addis Ababa University, Department of Public Administration and Development Management, Addis Ababa.
- Steingraber,S.,(1987): Resettlement and Villagization ;Tools of Militarization in southwestern Ethiopia. Cultural Survival Quarterly

# **An Exploratory Study on the Reverse Innovation of Tata Nano Motors**

**Bridget Chipanje**

School of Economics and Management,  
Zhejiang University of Science and Technology; Hangzhou, CN

**Doing**

School of Economics and Management,  
Zhejiang University of Science and Technology; Hangzhou, CN

## **Abstract**

*This article unpacks the concept of reverse innovation by exploring Tata motor's version of the Nano, dubbed world's cheapest car which was introduced in India. The paper explores the ideation process, product development and marketing strategies which were employed by the firm. The Nano was created with the Indian populace in mind thus it was a local production for local customers first before exporting to developed world, the product development of the Nano became known for its cost cutting features which influenced the promotion price at first but later increased due to the upgrading of the car. The car became famous for its cost cutting features such as three lug wheel nut, accessing the trunk from inside and one windscreen wiper among other features. The price was tagged at \$2000, which was equivalent to a motorcycle. Some notable aspects which impelled the successes of Tata Nano include hiring competent and knowledgeable human resource, creating synergies with chain supply for easy distribution. However the firm faced challenges which range from compromised safety standards, causing the car to catch fire, extended waiting period for the vehicle and lastly the marketing strategy which was not sustainable and ultimately led to the sales reduction.*

**Key words:** Reverse innovation, emerging economies, Tata Nano motor

## **1. Introduction**

Reverse innovation imply to a case whereby innovation is adopted first in poor or emerging economies before they 'trickle up' to rich countries (Govindarajan; 2011). Reverse innovation occurs in emerging economies targeting 'local customers' or the production of goods by emerging economies for 'up streaming', intended for rich countries. Instances of reverse innovation are on the rise in various fields such as General Electric, ultra cost sound scan, Grameen Bank (micro finance), Bharti's Airtell ultra cheap wireless telephony, BYD electric car and Tata Nano. Reverse innovation occurring in emerging economies bring novel products on the market which aim to solve pressing local issues and ensures the availability of cheap products on the market at the same time appealing to the growing middle income earners. The purpose aim of the study is to show the ideation, development and marketing process of Tata Nano. The dramatic cost and price reduction of the Nano created a product demand the cost cutting features on the

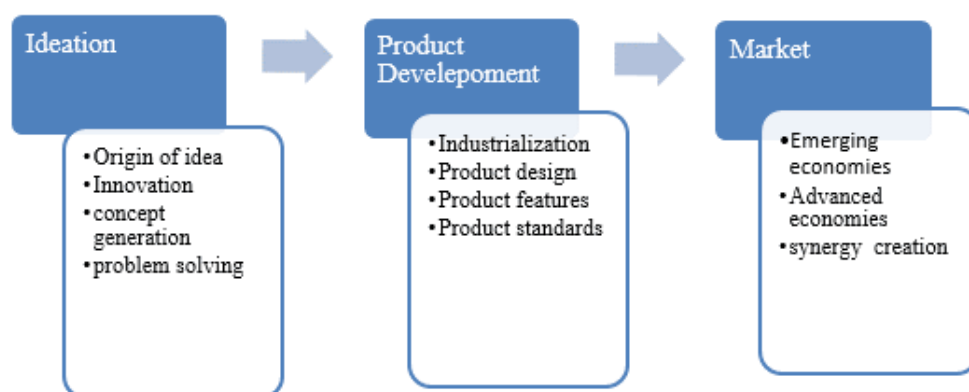
product motivated the drastic drop of the Nano. These factors in tandem with optimized marketing strategies, coupled with the hiring of experts ensured the success of reverse innovation. The study acknowledges that a combination of factors such as creating a viable and vibrant distribution team enabled the firm to have higher sales on the inception of the Nano vehicle. Additionally, synergy creation on chain supply ensured constant availability of the vehicle in the showrooms and various designated places where people frequented and more significantly partnering up with financial institutions that not only sold the vehicle but assisted farmers by availing loans to purchase the vehicle. However the firm faced some constraints such as extended waiting period for the car, safety concerns, stigma all these factors subsequently led to lower sales ultimately affecting the business and it led to the halting on production of the Nano model.

## 2. Unpacking the concept of reverse innovation

Maximilian (2009) describe reverse innovation as the inauguration of new products, initially launched in emerging markets and sold in emerged countries. Scholars as Govindarajan and Ramamurti (2011) aptly define reverse innovation as ‘an innovation that is adopted first in a poor country before being adopted in a richer countries’. Reverse innovation imply to a scenario whereby an innovation is adopted first in poor or emerging countries before it ‘trickles up’ to richer countries. Immelt et al (2009) indicate that reverse innovation is the opposite of ‘glocalization’ a system whereby many industrialized goods are made in developed countries and sold in poor countries. Seely-Brown and Hagel gave an elaborative definition by coining the term ‘blowback innovation’ which refers to innovative solutions coming from emerging economies. Reverse innovation is evident in diverse fields such as the General Electric in the health sector, Huawei within the technological fraternity and Tata Motors in the auto mobile industry

### 2.1 The Development of Tata Nano Motors

Fig 1; pictorial diagram depicting Tata Nano’s implementation of reverse innovation



Source compiled by researcher 2020

*2.2 Ideation and innovation;* Mr Ratum Tata the chairman of Tata motors one of the biggest automobile conglomerate was motivated to come up with the idea of the Tata Nano vehicle model after he saw a family of four crammed on a two wheeler scooter, a traditional mode of transport used by the poor and middle income Indians (Aggrawal;2014) . After witnessing the ordeal of that family he described the mode of transport which was used by the family as unsafe considering that the roads were poorly maintained. As a result he was motivated to come up with an idea of solving the problem he had seen, the solution was to design and come up with a small, affordable vehicle and cheaply produced vehicle which would be afforded by the poor folks and middle income earners. The Tata Nano, 'worlds cheapest' car was pegged at \$2,200 a figure which could buy a motorcycle which was popular among the poor and middle income earners.

*2.3 Concept generation;* the concept was generated and executed by a team which had been handpicked by the chairman of the company to produce a small and cheap car. This idea resonate with the tenet of reverse innovation which indicate that to ensure complete success in reverse innovation, strong technical and managerial competencies have to be considered (Von Zedtwitz et al 2015).

*2.4 Product development;* the engineers speedily turned the idea into a practical reverse innovation product in the form of a Nano car. The concept of reverse innovation is premised on the idea that products must be cheaply produced, at the same time meeting the required safety and product standards (Govindarajan and Trimble; 2014). Seemingly so the Nano vehicle was cheaply produced and the engineers introduced some cost cutting features. Singh and Joshi (2015) cite that the Tata Nano model was uniquely produced and designed so that it could appeal to the motorcyclist and scooter riders and the middle income earners generally. The idea behind the creation of Tata Nano model was to innovate, a product which was attractive and also being an affordable and cost-effective means of transportation for the deprived while considering the customer's expectations and meeting the regulatory requirements (Corsi et al 2014).

Tata motors embraced a new design of Nano to reduce the cost. In a bid to warrant spacious interior, lower weight and low costs, engine was strapped in the car's rear, with front wheel drive and the petrol tank to the front. This made the car more low-cost, efficient and compact. Material which included some fibre and plastics were opted for compared to steel to keep the weight of the car low. Singh and Joshi (2015) remind that the car did not have a radio, power windows, and air conditioning, anti-lock brakes, air bags, remote locks or power steering as a way of producing a low priced vehicle.

### *2.5 Product features*

*Table 1; indicate the cost cutting features of the Nano vehicle*

*Tata Nano's comparison with Maruti Alto 800, the closest competitor of the Nano*

<b>Tata Nano</b>	<b>Maruti Alto 800</b>
-One windscreen wiper instead of the usual two	-Two windscreen wipers
-Three lug nuts per wheel	-Four lug nuts per wheel
-No external fuel cap, fuel inlet accessed by opening the front hood	-External fuel cap
-Trunk was only accessible from inside the car, as the rear could not open. Eventually upgraded in the year 2015 to a hatchback	-One opening rear windscreen but also got a full hatchback
-No airbag on any model	-No airbag on any variant
-Radio or CD player was optional	-Radio or CD player was optional

Source; Govindarajan and Trimble (2014)

## 2.6 Marketing and Distribution strategies of the Nano model

The Nano vehicle was created first for the emerging economy of India with the intention that later it would trickle down to developed markets, hence India. Govindarajan and Trimble (2014), cite that the targeted people were those who belonged to the bottom of the pyramid who owned two wheelers, but who sought to own a four wheeler which was beyond their pocket. The product was first of its kind to be innovated, designed specifically for middle income earners and the poor class consisting mostly of farmers and transporters. Unique and novel marketing strategies were adopted which had never been used for marketing purposes by any firm. Tata motors managed to keep their communication campaign innovative and cost-effective, Tata motor advertised their new brand through the use of print medium and radio. Other innovative strategies were adopted to complement the afore mentioned forms of marketing and these included the use of online Nano games, Nano chat rooms, social media platforms of Nano conversations on facebook, orkut and blogs, Nano pop-ups on major websites launching Nano merchandise like baseball caps, key chains, and T-shirts etc. In addition, Westside, the Tata group-owned lifestyle retail chain, advertised Nano through text messages to customers (Richard, 2014). These forms of advertising ensured reaching a wider base of potential customers both in the city and periphery.

The distribution network of Tata Nano was unique as compared to other forms of distribution which have been used by other firms. The targeted clientele were poor and middle income earners, hence were frightened and hesitant to walk into large Tata Motors Ltd showrooms. To curb this and encourage people to buy the product a model was adopted of introducing some small retails and electronics megastore which did not frighten the customers (Westside and Chroma) outlets as well as auto dealerships (David; 2010). The firm entered into agreements with some preferred banks / Non-Banking Financial institutions (NBFCs). Singh and Joshi (2015) indicate that new insurance schemes were co-designed with five partner insurance companies to enhance the sales and service network for better reach and service to the customers. The prospective customers had to book Nano with INR 3,500 with the banks. From the bookings a lottery system was adopted to select customers for delivery of cars. The method adopted by Tata motors was unique and it saved its purpose in ensuring that people got the vehicle through various platforms.



### **3. Success type of the Tata Nano model**

Hiring appropriate human resource propelled to the success of the Tata motors, in successfully launching the Nano model. For reverse innovation to be successful knowledgeable and skilled personnel are needed hence such people were hired by the firm. The policy aspect was prioritised, educational policies were put in place and cascaded covering issues of safety and further indicating the significance of reverse innovation in emerging economies. Furthermore another key success area of Tata motors was the creation of synergies in supply chain with other companies. Notable examples of such synergies which were created are that of Tata motors establishing an alliance with the German brand of Mercedes Benz, and later on purchasing Land Rover and Jaguar (Aschmonet and Janevska 2013). Shouldering with such brands has enabled market power and ensured successive reverse innovation (Govindarajan et.al 2012). Additionally the Nano model managed to penetrate new markets with the new product, although the product was received with mixed emotions but what but the product essentially appealed to the middle income earners and the afforded an opportunity for people to buy a brand new car.

### **4. Challenges to the Tata Nano**

The Nano faced some challenges, which include facing some mixed reception from the Indian customers. The reasons forwarded were that the car was still expensive as compared to the motorcycle thereby forcing customers to continue buying the motorcycle. Constant improvements on the car by the manufacturer propelled the price of the car to rise beyond what the customers could fork out. Coupled with the above issues the customers had to deal with the extended waiting period, of delivery for the car. Although the car was the most affordable car, people opted to buy the second hand car which in terms of pricing was more expensive but gave them the social status compared to the affordable Nano. The Nano model did not get a good reception on the market as it had a tag of being the world's cheapest car thereby the vehicle was seen as a poor man's car any association with car stigmatised the buyer this was a challenge because many people opted not to buy the vehicle especially those who had more money than the middle income earners. The concept of reverse innovation emphasise on good standard when it comes to products, while it is premised on cutting costs but the final product has to meet acceptable safety standards. Incidents of the car catching fires became rampant and it caused some serious concerns among the potential buyers and the customers who already owned the vehicle. Aggrawal (2014) reminds that Nano lacked the essentials which ensured the protection of product itself and the user of the product. The cost cutting features of the product, such as omitting the fuel cap on the fuel tank made the vehicle prone to catching fires and it meant risking the lives of the buyers, owners and passengers at risk. Kumar (2018) attest to the fact that quite a number of Nano model caught fire which prompted the general consumers to question the safety of people particularly the consumers. Adding to the woes of the firm, the marketing strategy for Nano did not work out as planned and this led to the massive reduced sales of the car compared to what had been projected.

### **5. Conclusion**

The findings of this study clearly shows that the reverse innovation of Tata Nano was first adopted in an

emerging economy, for the local Indian customers first before ‘trickling up’ to rich countries. Tata Nano was a cheap car which came as a result of reverse innovation which intended to provide a safe mode of transport compared to the motorcycle which the populace had been inured to. Additionally the factors which ensured success of the concept were the product cost cutting features, hiring experts and a vibrant team of engineers and the creation of synergy on chain supply and partnering up with financial institutions played a pivotal role in the success of reverse innovation. However the firm faced some challenges which range from safety concerns caused by fires catching the car, worsened by the delays caused extended waiting period and the stigma which became attached to the car as the poor man’s car. As the case shows, if reverse innovation is properly implemented it can achieve more in emerging economies.

## 6. Reference

- Aggrawal, Y (2014) Reasons why Nano did not take off as expected. <http://www.letuspublish.com> (accessed 10 January 2020)
- Corsi, S 2012, Reversing the International Flow of Innovation: How Does Chinese Market Trigger Reverse Innovation? Doctor of Philosophy, Scuola Superiore Sant’Anna, [http://www.phdmanagement.sssup.it/documenti/awarded/corsi\\_thesis.pdf](http://www.phdmanagement.sssup.it/documenti/awarded/corsi_thesis.pdf) (accessed 12 December 2019)
- Corsi, S, Di Minin, A & Piccaluga, A 2014, ‘Reverse Innovation at Speres: A Case Study in China’, *Research Technology Management*, vol. 57, issue 4, August, pp. 28-34, (online EBSCOhost
- Christen, C.M (1997). The innovators dilemma; when new technologies cause great firms to fail. *Harvard Business Review*
- David, R (2010). Tata Nano unveils its \$2,500 car. <http://www.forbes.com> (accessed 14 February 2020)
- Govindarajan, V (2009). What is reverse innovation? Vijay Govindarajan’s blog <http://www.tuck.dartmouth.edu> (accessed 14 February 2020)
- Govindarajan, V (2012) . A Reverse innovation playbook. *Harvard Business Review*- April pp120-124
- Govindarajan, V (2010) .The case of ‘reverse innovation’ now. *Business week online* pp 13
- Immelt, J.R, Govindarajan, V and Trimble, C (2009). How GE is disrupting itself. *Harvard Business Review*, 87(10); 56-65
- Kumar, Arjun (2017). Tata Nano sales at an all time low, 174 units sold in March. <http://www.motorbeam.com> (accessed 10 January 2020)
- Soni, P 2013, ‘Reverse Innovation: Create Far from Home, Win Everywhere’, *South Asian Journal of Management*, vol. 20, issue 4, December, pp. 160-163, (online EBSCOhost)
- Utterback, J M (2004). The dynamics of innovation. *Educause Review*, January-February, pp 42-51
- Von Zedtwitz, M (2004). Managing foreign R and D laboratories in China; *R and D Management*, 34(4); 439-452
- Williamson, P (2010). Cost Innovation; preparing for a ‘value-for money’ revolution. *Long range planning*.43 (2-3); 343-353
- Von Zedtwitz, M, Corsi, S, Søberg, PV & Frega, R 2014, ‘*A Typology of Reverse Innovation*’ *Journal of*

Product Innovation Management, vol. 32, issue 1, June, (online Wiley Online Library)

Zeschky, M, Widenmayer, B & Gassmann, O 2014, 'Organising for reverse innovation in Western MNCs: the role of frugal product innovation capabilities', International Journal of Technology Management, vol. 64, issue 2-4, March, pp. 255-275, (online EBSCOhost

Zeschky, MB, Winterhalter, S & Gassmann, O 2014, 'From Cost to Frugal and Reverse Innovation', Research Technology Management, vol. 57, issue 4, August, pp. 20-27, (online EBSCOhost)

# **University Social Responsibility and The Control Mechanisms of The Ministry of Education from A Systemic View**

**Mirlene Rabelo Magalhães Dias**

mirlene.mgalhaes@gmail.com

Postgraduate Department of the University of Fortaleza - PPGA, CE - Brazil

**Maurício Wilker de Azevedo Barreto**

wilker.a.barreto@gmail.com

Postgraduate Department of the University of Fortaleza - PPGA, CE - Brazil

**Cinara da Silva Cardoso**

cinaracardoso@hotmail.com

Postgraduate Department of the University of Fortaleza - PPGA, CE - Brazil

**João Fernandes Neto**

casaraodeideiasam@gmail.com

Postgraduate Department of the University of Fortaleza - PPGA, CE - Brazil

**Randal Martins Pompeu**

randal@unifor.br

Postgraduate Department of the University of Fortaleza - PPGA, CE - Brazil

## **Abstract**

*This article aims to analyze whether University Social Responsibilities - USR is regulated in the control mechanisms that inspect and allow the opening and continuity of a Higher Education Institution, making an analysis as to whether the MEC assessment instruments are efficient in the implementation of a socially responsible organizational culture, having as a reference the systemic view, which allows a macro analysis from the legal side. It is a qualitative research, where the documentation of the Higher Education legislation was analyzed, using techniques to understand the object of study in its entirety, but whose raw material is the legislation that deals with the evaluation systems and the Instruments for Assessment of Accreditation of an HEI and course. The importance of this research is due to the fact that it performs an analysis to find out how USR is inserted in the legislation, and that the absence of a clear and objective legislation, make the HEIs comply only with what is required by law, that is, the minimum , and in accordance with legislation.*

**Keywords:** *University Social Responsibility; Evaluation instruments of the Ministry of Education; University education.*

## **1. Introduction**

There is a paradox between economic development and social responsibility, becoming more complex when you think about private higher education institutions, which is a company, a business, which aims to profit, but which has the responsibility to train responsible professionals in the face of the problems caused by Capitalism, among them the social class difference, the exclusion of the rights to quality education and health, among other factors.

Universities build knowledge, science, and not only reproduce knowledge, this construction takes place through interaction and proximity to the community, which present social problems, and end up serving as a framework of experience, transformed into knowledge and learning for the academic community, and which has a duty to transform lives.

The article analyzes the laws that create a Higher Education Institution and the laws that control its continuity, from a systemic view, and it is important to have more effective regulation, so that University Social Responsibility (USR), is of fact in effect. It will focus on the laws that serve as parameters for on-site visits, which are responsible for authorizing the opening of an HEI and its respective courses, and subsequently undergo a new visit by MEC / Inep, to evaluate the implementation of the project presented in moment of its opening, and the next visits take place to renew the accreditation of the HEI or to renew the recognition of the course.

## **2. Methodology**

The methodology adopted was first based on an exploratory study, which is configured in the preliminary study, carried out with the objective of appropriating more about the knowledge of the object and the reality to be researched.

Thus, exploratory research led to a process of reflection and an initial questioning that the HEIs have a fundamental role on University Social Responsibility, and if it is regulated, in a transversal, objective and clear way, if there is an advance there more on the topic, but research will show that such regulation needs to move forward and improve government control mechanisms.

The research is qualitative because there was an interpretation and analysis of the laws of higher education, and the documentary research is part of a qualitative approach, where it focused mainly on the main laws of the MEC evaluation system, in order to analyze how University Social Responsibility is covered by legislation. I emphasize that there is extensive documentation on the subject, but I highlight the legislation below, which served as a basis, for the universe of the study:

- Federal Constitution of 1988;
- Law No. 9,394, of December 20, 1996, which establishes the guidelines and bases of national education;
- Law No. 10,861, of April 14, 2004, which institutes the National Higher Education Assessment System - NHEAS;
- Resolution No. 7, of December 18, 2018, which establishes the Guidelines for Extension in Brazilian Higher Education and regulates the provisions of Goal 12.7 of Law No. 13,005 / 2014, which approves the National Education Plan - NEP 2014-2024 and makes other provisions;

- Normative Ordinance No. 20, of December 21, 2017, which provides for the procedures and decision-making standards for the accreditation, re-accreditation, authorization, recognition and renewal of higher education processes, as well as their amendments, in the face-to-face and distance education, from higher education institutions in the federal education system;

- Ordinance No. 23, of December 21, 2017, deals with the flow of the processes of accreditation and re-accreditation of institutions of higher education and of authorization, recognition and renewal of recognition of higher education courses, as well as their amendments;

- Instrument for evaluating on-site and distance undergraduate courses (authorization, recognition and renewal of recognition), 2017, Inep / MEC;

- Instrument for evaluating on-site and distance undergraduate courses (authorization, recognition and renewal of recognition, 2017, Inep / MEC.

A qualitative analysis of the legal documentary research was carried out, and a bibliographic search of primary and secondary sources on the theme, University Social Responsibility, which supported the work, as well as administrative theories, from which the systemic theory was chosen.

### **3. Discussion**

The term Social Responsibility - SR appears first for companies, where it was argued that they should behave socially responsible for future generations and a better world, precisely with the States and society in general. It is not intended to make a history of terminology, but in the 21st century, the topic has come to be discussed more and more, in companies, universities and other segments, as it requires an ethical and responsible posture, and should be part of the culture of organizations.

About Social Responsibility - SR, informs Oliveira (203, p.121), "...it is not a separate activity from education, but a new form of education, more comprehensive and conscious; it is not restricted to isolated activities on certain dates; on the contrary, it becomes part of people's daily lives, intrinsic in every gesture, in every thought".

It is based on the principle that Higher Education Institutions-HEI, have a fundamental role when dealing with this theme, since they are responsible for the integral formation of citizens with competences and skills, in addition to the production of new knowledge, not only bringing a systematic and conceptual knowledge on the subject, but that can be an example, be part of the culture of organization of all involved, students, teachers, managers and administrators, and thus form socially responsible citizens.

For Vallaeys (2017) SR is a new responsibility that must complete the moral and legal responsibility, and it must be collective and not personal. The author informs that:

Moral and legal responsibilities regulate our actions, while social responsibilities regulate our impacts, that is, not what we do with their immediate and local consequences, but what produces what we do with remote and global systemic emergencies. Once we understand that social responsibility is a responsibility for impacts and that impacts are not acts, we can address, in all theoretical and practical wealth, what social meaning in organizations and in particular universities (Vallaeys, 2017, p. 2).

The author makes it clear that SR as an act, is only in the moral and legal dimensions, being necessary to conceive it as a global impact, and to understand it as an impact it is necessary to understand



the three dimensions of complex ethics, outlined in table 1 a follow:

Table 1 - The three dimensions of complementary ethics

<b>Ethics in “3D”</b>	<b>1st dimension: Self-ethics</b>	<b>2nd dimension: Socio-ethics</b>	<b>3rd dimension: Autropo-ethics</b>
Types of duties	Virtue	Justice	Sustainability
Subject of duty	The person (personal duties)	The community (interpersonal duties)	Humanity (transgenerational duties)
Duty object	The acts	The laws	The world
Scope of the obligation	The personal conscience	The rule of law	International governance
Type of responsibility	Moral responsibility	Legal responsibility	Social responsibility
Liability generator	Evil itself and the pain of others	The illegal act and injustice	The negative impact and systemic unsustainability
Regulation mode	The moral	The right	The politics

Source: adapted from Morin, 2004 and Vallaey, 2011 (apud Vallaey, 2017, p. 3).

The author makes it clear that none of the three dimensions are separated or overlapping, or even to a greater degree of relevance than the other, as it is necessary to understand SR in the dimensions of morality, law and politics. And one can question why the emphasis on the legal, legal part of this article, when the three dimensions must go together. The answer to that is that HEIs are regulated by a rule of law, and by that act they are created, accredited and inspected, allowing their continuity, and when there is no well-defined regulation, there is a weakness in the rule of law, allowing the continuation of unsustainable practices, which work in the logic of the market and profit. In addition, the absence of regulation reflects the plurality of responses from HEIs, or peculiar social actions, and generally isolated and supportive efforts by teachers, as has been seen, with no uniform and homogeneous movement, which causes a social impact, that may be a legal condition for being part of an institution's organizational culture.

The global capitalist world, where social inequalities have increased, with deep marks of poverty and social exclusion, like Brazil, it becomes difficult to “govern each other”, regulation is necessary to create conditions capable of to require from HEIs a USR, with social, political, civil, economic and cultural impacts on society.

It is not intended here to show the overvaluation treated in the 2nd dimension “Socio ethics” presented by the author Vallaey (2017), in the case of law, shown in the table above, or that an evolution of the 2nd dimensions is necessary to reach the third dimension, but rather, realize that if one of the dimensions is not structured, well defined in your country, you will not reach the full co-responsibility regulated in ethics, law and the market. Vallaey (2017) also adds to these three, the programmed self-regulation, a light law, where everyone is obliged, according to table 2 below:

Table 2 - Possibilities for regulating collective action

Ethic	Unscheduled self-regulation: Personal commitment	I force myself	My law
Market	Unscheduled hetero-regulation: Systematic feedback	He forces us	No law
Right	Programmed hetero-regulation: Legal Coercion	The law obliges us	Hard law
Partnership	Programmed self-regulation: Mutual obligation	We commit ourselves	Soft law

Source: Adapted from Vallaeys (2017).

It can be seen in table 2, that the author treats law, regulation, as programmed hetero-regulation, where there is a legal constraint, the law that enforces it, a tough law. However, regulation, State intervention, which is dealt with in this article, is a sine qua non condition, without which it should not exist, not thinking of the coercive way, but of controlling living conditions, not often allowing the opening of an HEI, when it does not have the necessary operating conditions, from its own physical environment to an education without social responsibility. In addition, a regulation will not allow economic exploitation, on the contrary, regulation can enable market balance, when there is a Government that is committed to society, and that needs to regulate in terms of a common good, and not depending on the market and companies.

The absence of regulation favors private power, leading to the exploitation and usurpation of rights. We can cite as an example the absence of regulation in the MEC (2017) course evaluation instrument in dimension 2, as shown in table 3 below, which deals with the teaching staff and tutorial, in the teaching staff indicator: degree, as shown in table 3 below, makes no mention of a *stricto sensu* title, with the exploitation and devaluation of qualified labor. Only in indicators 2.1 that deals with the Structuring Teaching Nucleus and in indicator 2.13 Titration and training of the tutors' body, that there is a minimum requirement for teachers with *stricto sensu* training, without distinguishing between doctors and masters.

Table 3 - Indicator 2.5 Faculty: degree

CONCEPT	ANALYSIS CRITERIA
1	The faculty presents the contents of the curricular components without addressing their relevance to the student's professional and academic performance.
2	The teaching staff describes the contents of the curricular components, addressing their relevance for the student's professional and academic performance, but does not encourage critical reasoning based on updated literature.
3	The faculty analyzes the contents of the curricular components, addressing their relevance to the student's professional and academic performance, and promotes critical thinking based on updated literature, in addition to the proposed bibliography.
4	The faculty analyzes the contents of the curricular components, addressing their relevance to the student's professional and academic performance, fosters critical thinking based on updated literature, in addition to the proposed bibliography, and provides access to cutting-edge research content, relating them to the objectives of the disciplines and the profile of the graduate.
5	The faculty analyzes the contents of the curricular components, addressing their relevance to the student's professional and academic performance, fosters critical thinking based on updated literature, in addition to the proposed bibliography, provides access to cutting-edge research content, relating them to the objectives of the disciplines and the profile of the graduate, and encourages the production of knowledge, through study or research groups and publication.

Source: Adapted from Brasil / MEC / Inep, 2017.

I could cite several examples, where the regulations favor companies in acting to maximize profit, but the problem is not only in the act of regulating, but also the failure of the public power to want to benefit the private power, and to make a flawed, generalist regulation. , omitted and that makes it possible for USR, as will be seen later, to not be efficient in the law, because it is also regulated as an action, an act, and in a generalized way to benefit private educational companies.

It is for this reason that it was adopted to analyze the USR and its regulation on systemic optics or general systems theory, developed by the biologist by Bertalanffy, who assumed that it is not possible to study the isolated parts, and should analyze the whole and its interdependence (Reis and Bando, 2012).

According to the authors Reis and Bando (2012) to understand a reality it is necessary to know the components that are part of an open system, which are: the inputs, the inputs, their interactions, relationships and outputs and the feedback process, as shown in the figure 1 below.

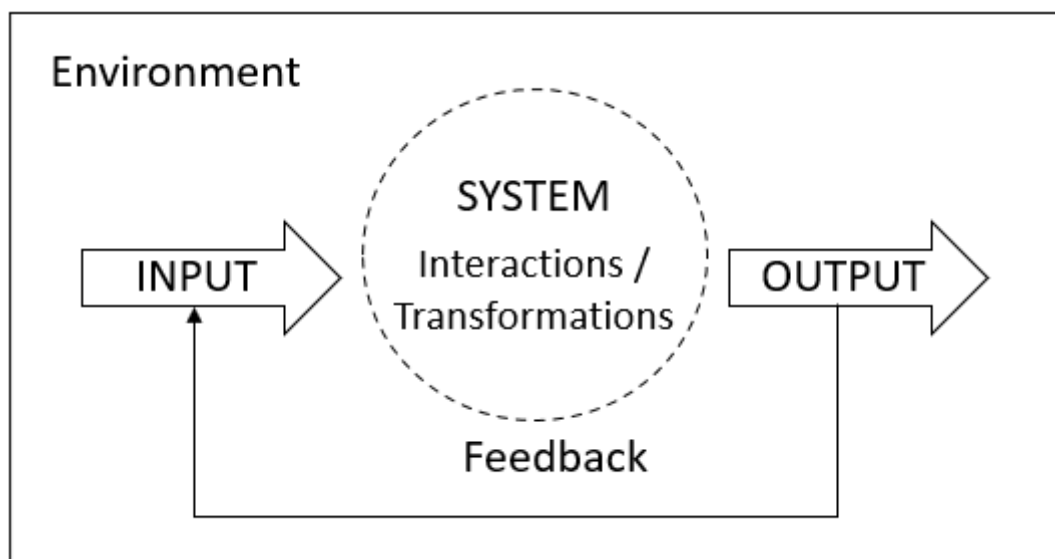


Figure1: Scheme of an open system.

Source: Reis e Bando, 2012

It should be thought that in addition to the elements that make up this systemic view, presented above, it is also necessary to present the academic axes used by the author Vallaeys (2017), which impact on HEIs, and which are expressed in figure 2 below:

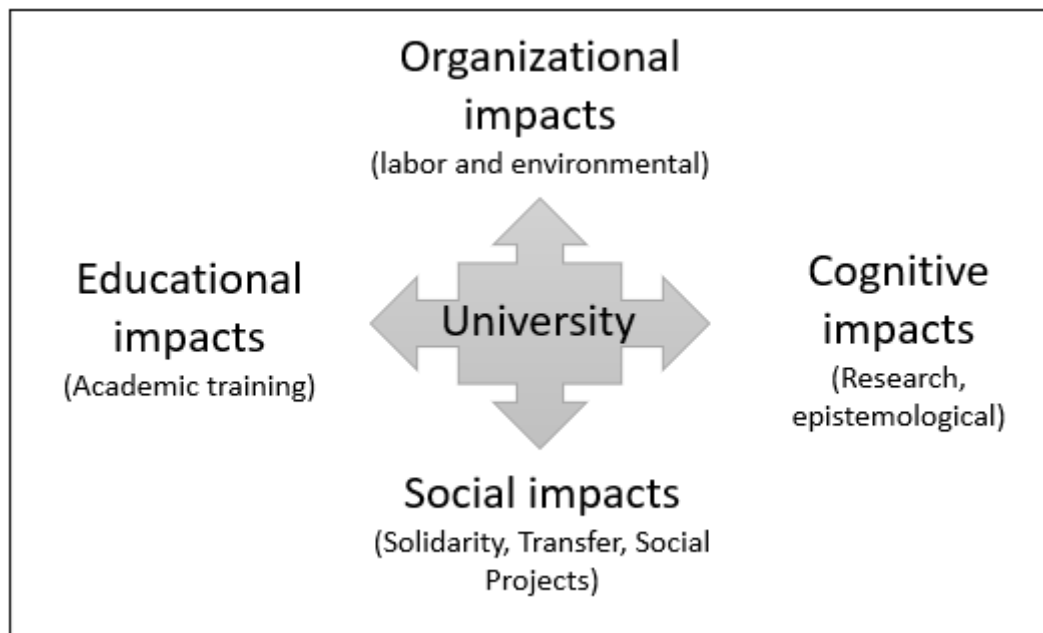


Figure 2: Relevant impacts at the University.

Source: Vallaey (2017).

In the figure above, author Vallaey (2017) treats impacts as risks of not fulfilling the true mission of a University, of speaking and not doing. The author lists, in his text, what impacts may occur in each sphere: in the organizational: maltreatment at work, lack of democracy and transparency, bad environmental habits, institutional ethical inconsistencies, etc; in the cognitive: academic disconnection - society; scientific irresponsibility, fragmentation of knowledge, lack of transdisciplinarity, etc. in the educational: hyperspecialization (blind intelligence), lack of ethical training and citizenship, reduction of training to employability, etc; in the social: commercialization of extension, assistance, paternalism, indifference to social problems

Based on the two figures, by Reis and Bando (2012) and Vallaey (2017), an adaptation proposal was constructed on how the problem of the HEIs and its USR can be conceived through the systemic view, as shown in the figure below:

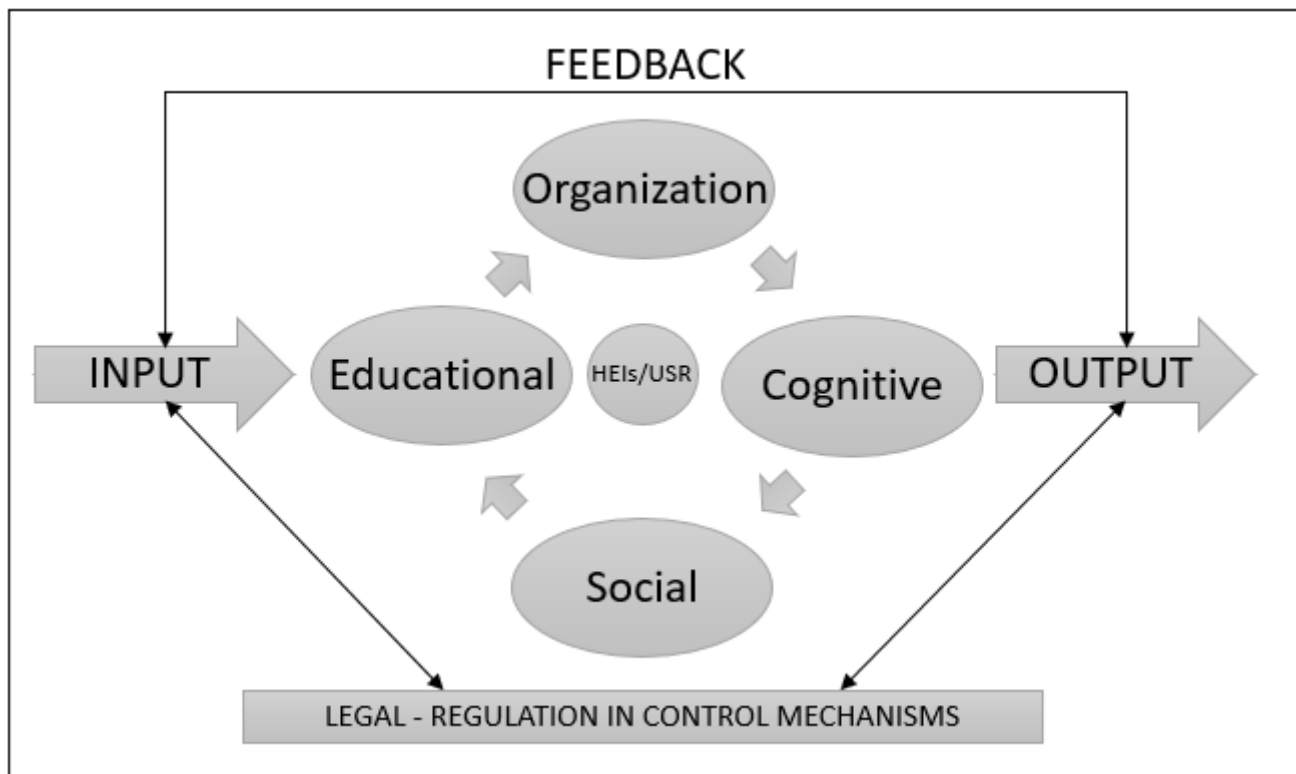


Figure 3: HEIs / USR in a Systemic view.

Source: Adaptation of the figures of the authors Reis and Bando (2012) and Vallaey's (2017),

In figure 3 above, an HEIs is presented, from a systemic view, which should be: regulated, but legislation that benefits society, detached from only business interests, does not intend to form an alliance in the “Triple Helix” model, a term used by Etzkowitz, Leydesdorff, (1997 apud Vallaey's, 2017), where there is an alliance between State, Company and Universities, and there would be a “business science”, but to think that private education is possible, where USR can be seen in a transversal way, an education committed to science and society. According to the last Higher Census of 2018, Brazil has 2,537 higher education institutions, of which 299 are public institutions and 2,238 are private institutions, representing 88.2% of the total. There is no doubt about the growth of private HEIs and the commercialization of education in the vast majority, but to request the extinction of private HEIs, is to demand that other companies from other segments are extinguished. What is proposed is a regulation since the beginning of the opening of an HEI, where it is possible to demand sustainable buildings, a higher percentage of doctors, research and the USR can be regulated in the control mechanisms, because today there is a silence and a gap. In addition, not to see as an action, but projects with social impacts, with this there will be a minimization of profit, and a commitment to quality education;

- Input, this is the entry of an entire academic community, students, teachers and employees who will be involved in all aspects, organizational, cognitive, social and educational, in an HEI, where from the beginning there was a regulation aimed at to serve the community, and where all social problems will be addressed in all organizational, educational, social and cognitive dimensions, with feedback, through other assessments to public authorities, that regulate HEIs;

- Output, this academic, administrative community, managers, teachers and trained students can return to

their spaces, continuing a practice experienced within the university space, in a responsible way, with feedback, through other assessments to the public power, which regulate HEIs.

It is necessary to think of all figure 3 within a macro context, taking into account every economic, social, political and cultural context, being a proposal to think about an HEI and its USR.

## 4. Results

HEIs are regulated by the Ministry of Education (MEC), which, through its laws, decree, ordinances, and other instruments, establish the standards that HEIs must follow, and there is also the control process by MEC, to assess whether they are complying with all regulations, often leading to penalties, which can even lead to the disqualification of an institution. For this reason, the need to understand the control mechanisms from a systemic view, since legislation, when instituted, starts to make culture and, consequently, the planning of an Institution.

As the author informs François Vallaëys (2018, p, 11) when dealing with the theme, he informs that one of the important items is to have “a firm commitment to public policy, **mandatory** and universality sustained in the State, and not the total agents' discretion (we do what we want, how we want and when we want) ”(emphasis added)

For a long time it was rooted in particular HEIs conceptions as SR should be:

- SR is up to the Government because they are already contributing through taxes, the public sector being responsible for the application;
- SR through its teaching, where the HEIs already fulfilled this premise for delivering to society professionals prepared for the job market, forgetting that it is a basic premise to offer quality education, and to deliver society to a prepared citizen in all areas. its dimensions;
- SR through extension, which would be philanthropic and assistance actions, through donations and services provided to the community, in a timely manner, without continuity, and often without being part of the planning, and according to the reality of the moment, with few impacts on people's lives. A practice widely used by HEIs and “approved” in Brazil by the Brazilian Association of Higher Education Maintainers (*Associação Brasileira de Mantenedoras de Ensino Superior - ABMES*), and launches the Social Responsibility Campaign for Private Higher Education, for a week, usually in September, and issue an HEIs Seal Responsible, but that in the great majority constitute philanthropic and welfare actions.

It is still very recurrent in Brazil, on the part of HEIs to have USR, according to the latest reality, that is, philanthropic services, being an action already awaited by the population, who also end up having a distorted view on RS. According to Carrol and Schwartz (2003, p. 3) informs that: "currently, the evidence indicates that the majority of companies donate to charitable organizations ... and that the majority of the population expects companies to do charity". This practice is also reproduced in Higher Education Institutions.

To understand this USR, from private HEIs, we need to analyze the educational legislation, because the Law of Directives and Bases of Education (*Lei de Diretrizes e Bases da Educação – LDB*) 9.391 / 1996, brought up this issue, when dealing in its Art. 1, paragraph 2, that the “ formal education should be linked to the world of work and social practice ”. But what would this Social practice be? The author Gasparim

(2003, p. 21) refers to social practice in the dialectic perspective as being: “[...] a totality that encompasses the way men organize themselves to produce their lives expressed in the social institutions of work, family, school, church, media unions, political parties, etc.”

Thus, LDB 9394/96, even though it did not express the word USR, brings in its core, how HEIs should interact with society, in a very broad way, giving different interpretations, which often made HEIs act indifferent with regard to their USR.

It will be in Law nº 10.861, of April 14, 2004, which institutes the National Higher Education Assessment System (*Sistema Nacional de Avaliação da Educação Superior – SINAES*) and provides other measures, and for the first time the word Social Responsibility is mentioned in the educational legislation of MEC:

Art. 3 The evaluation of higher education institutions will aim to identify their profile and the meaning of their performance, through their activities, courses, programs, projects and sectors, considering the different institutional dimensions, including the following:

I - the institutional development mission and plan;

II– the policy for teaching, research, postgraduate studies, extension and the respective forms of operationalization, including procedures to stimulate academic production, research grants, monitoring and other modalities;

III - the **social responsibility** of the institution, considered especially with regard to its contribution in relation to social inclusion, economic and social development, the defense of the environment, cultural memory, artistic production and cultural heritage. Brazil, Law 10.861, of April 14, 2004, which institutes the National Higher Education Assessment System (*SINAES*)

For the author Fagundes (2014, p. 1) the *SINAES* legislation enabled a primordial premise, since “[...] it is to register that the figure of social responsibility now has the condition of an institutional dimension that is part of the evaluation procedure of the institutions of higher education. ”

Therefore, RS, in 2004, started to be regulated by *SINAES*, and it is still a small advance, in the context where there is a whole discussion about the sustainability of the planet, the social differences, which demand that the HEIs are capable to understand social problems, make an intervention, and don't just think about profits, but bring social problems into the university community in a dialectical way, being part of the curricula across.

Every law aims to regulate the market, dictate rules of conduct in a society, and there are also control mechanisms, in the case of HEIs, there are a series of evaluations by the Ministry of Education / Inep to find out whether they are complying with the rules or not. . Within the scope of *SINAES*, an on-site assessment is expected, where a team is designated by Mec / Inep, for the processes below:

- Accreditation and re-accreditation of an HEI: carried out by three evaluators, drawn from among those registered with the National Bank of Evaluators (*Banco Nacional de Avaliadores - BASis*), specialists in the area, and the vast majority with a strict sensu title

- Course authorization and recognition: carried out by two evaluators, drawn from among those registered with the National Bank of Evaluators (*BASis*), specialists in the area, and the vast majority with



a strict sensu degree

Both cases above are on-site visits, which are carried out by randomly selected evaluators among those registered with the National Bank of Evaluators (*BASis*), specialists in the area and with a strict sensu title, and the number of evaluators is: three when it comes to accreditation and re-accreditation of HEIs and 2 evaluators when referring to course evaluations.

The on-site visits are based on the instruments below, which are fully based on Law No. 10,861 / 2004 of the National Higher Education Assessment System (*SINAES*), which provides for periodic assessment at the HEI, with 2 instruments:

1. **Institutional Evaluation** Instrument: External, On-site and Distance: Accreditation Transformation of Academic Organization;

2. Instrument for **Evaluation of Courses** of Graduation, On-site and Distance Learning.

The first instrument evaluates the Institution and the second its courses, and are used by the evaluators as a tool to “evaluate” the Institutions and their courses, and should assign a concept from 0 to 5.

The External Institutional Assessment Instrument, which assesses the Institution, is composed of 5 axes, with a total of 50 indicators, and each indicator is worth a score from 0 to 5, are:

1. Axis 1 - Institutional Planning and Evaluation, with 5 indicators
2. Axis 2 - Institutional development, with 7 indicators
3. Axis 3 - Academic policies, with 12 indicators;
4. Axis 4 - Management policies, with 8 indicators;
5. Axis 5 - Infrastructure, 18 indicators

As the Assessment Instrument for On-Campus and Distance Graduation **Courses**, they **evaluate** the 3 dimensions of a course:

- 1 Dimension 1: Didactic-Pedagogical Organization
- 2 Dimension 2: Faculty and Tutorial 3
- 3 Dimension 3: Infrastructure.

The table below shows where USR is mentioned in the two assessment instruments, which serve as a mechanism for controlling and authorizing the functioning of an HEI and its courses:

Law No. 10,861, of April 14, 2004, which institutes the National Higher Education Assessment System - SINAES	External Institutional Evaluation (Brasil / Mec / Inep, 2017)	Evaluation of On-campus and Distance Undergraduate Courses (Brazil / Mec / Inep, 2017).
Art. 1, Paragraph 1 The purpose of SINAES is to improve the quality of higher education, to guide the expansion of its offer, to permanently increase its institutional and academic and social effectiveness, and especially to	<p><b>Axis 2 - Institutional Development</b></p> <p><b>Indicator 2.1</b> - Mission, objectives, goals and institutional values</p> <p><b>Concept 5:</b> The institution's mission, objectives, goals and values are expressed in the PDI, communicate with teaching, extension and research policies (the latter,</p>	<p><b>Dimension 1 - Didactic Organization - Pedagogical</b></p> <p><b>Indicator 1.1 Institutional policies within the scope of the course</b></p> <p><b>Concept 5:</b> The institutional</p>

promote the deepening of commitments and <b>social responsibilities</b> of higher education institutions, by enhancing their public mission, promoting democratic values, respecting difference and diversity, affirming autonomy and institutional identity. (boldface).	considering the academic organization), are translated into actions internal institutional, transversal to all courses, and external, through <b>social responsibility</b> projects.	policies for teaching, extension and research (when applicable), contained in the PDI, are implemented within the scope of the course and clearly aimed at promoting learning opportunities aligned with the profile of the graduate, adopting proven practices successful or innovative for its review.
Article 2, item I - institutional assessment, internal and external, contemplating the global and integrated analysis of dimensions, structures, relationships, social commitment, activities, purposes and <b>social responsibilities</b> of higher education institutions and their courses; (boldface)	<p><b>Axis 2 - Institutional Development</b></p> <p><b>Indicator 2.3:</b> IDP, research and scientific initiation policy and practices, technological innovation and artistic and cultural development.</p> <p><b>Concept 5:</b> There is an alignment between the PDI and the policy and practices of research or scientific initiation, technological innovation and <b>artistic and cultural development</b>, with academic practices focused on the production and interpretation of knowledge, with lines of research and work across courses offered and mechanisms for transmitting results to the Community.</p>	<p><b>Dimension 1 - Didactic-Pedagogical Organization</b></p> <p><b>Indicator 1.3:</b> Professional profile of the graduate Concept 5: The professional profile of the graduate is provided for in the PPC, is in accordance with the DCN (when applicable), <b>expresses</b> the skills to be developed by the student and <b>articulates</b> them with local and regional needs, with <b>planning</b> for its expansion due to new demands presented by the world of work.</p>
Art. 3 Item III - the social responsibility of the institution, considered especially with regard to its contribution in relation to social inclusion, economic and social development, defense of the environment, cultural memory, artistic production and cultural heritage ; (boldface)	<p><b>Axis 2 - Institutional Development</b></p> <p><b>Indicator pain 2.4</b> PDI, institutional policies aimed at valuing diversity, the environment, cultural memory, artistic production and cultural heritage, and affirmative actions for the defense and promotion of human rights and ethnic-racial equality.</p> <p><b>Concept 5:</b> The PDI has institutional policies that translate into actions aimed at valuing diversity, the environment, cultural memory, artistic production and cultural heritage, and in affirmative actions for the defense and promotion of human rights and ethnic equality -racial, in a <b>transversal way</b> to the courses offered, expanding the competences</p>	<p><b>Dimension 1 - Didactic-Pedagogical Organization</b></p> <p><b>Indicator 1.5:</b> Curricular content <b>Concept 5:</b> The curricular contents, contained in the PPC, promote the effective development of the professional profile of the graduate, considering the update of the area, the adequacy of the workloads (in clock hours), the adequacy of the bibliography, the methodological accessibility, the content approach pertinent to the <b>policies of environmental</b></p>

	of the graduates and offering mechanisms of transmission of the results to the community.	<b>education, education in human rights and education of ethnic-racial relations and the teaching of Afro-Brazilian, African and indigenous history and culture</b> , differentiate the course within the professional area and induce contact with recent knowledge and innovative.
	<p><b>Axis 2 - Institutional Development</b></p> <p><b>Indicator 2.5</b> IDPs and institutional policies aimed at economic development and social responsibility.</p> <p><b>Concept 5:</b> there is alignment between the PDI and institutional policies for economic and social development, considering the improvement of the population's living conditions and the actions of inclusion and entrepreneurship, articulating the objectives and values of the HEI, and the promotion of actions recognized successful or innovative. (Brazil / MEC / Inep, p.</p>	
	<p><b>Glossary</b></p> <p><b>HEI's social responsibility:</b> Refers to the institution's actions (with or without partnership) that contribute to a more just and sustainable society, considering works, actions, activities, projects and programs developed aimed at the community, aiming at social inclusion, development economic and improving the quality of life and local infrastructure (Brasil / MEC / Inep, 2017, p. 41).</p>	

When analyzing the “External Institutional Assessment” instrument, which had 5 axes, with 50 indicators, the following conclusion was reached:

- SR is required only in axis 2, called “Institutional Development”, not being part of the other 4 axes that deal with planning, management, academic and infrastructure, and does not permeate the entire instrument, in a transversal way, which it will not allow an impact on reality, since the 5 axes are the basic pillars of an HEI;

- Of the 50 indicators, there is only reference to SR in 4 indicators, which represents 8%, verifying the lack of requirements of USR, which requires investment by HEIs;
- In Indicator 2.1, the term RS is only mentioned in concept 5, which allows an HEI to obtain concept 3 and have approval for their projects, since in concept 3 there are no requirements and there is no talk about SR;
- Indicators 2.3 and 3.4: the items valuing diversity, the environment, cultural memory, artistic production, cultural heritage, artistic and cultural development, which is part of the USR, are charged across the board only in concepts 4 and 5, when transversality should permeate every instrument, and is present in all concepts, forcing HEIs not to fulfill the minimum requirement, because with concept 3, it allows the approval of an HEI accreditation project and its courses, but transversality it is not required in this concept;
- There is a definition at the end of the instrument, in the Glossary, about Social Responsibility in HEIs, when it informs that: “It refers to the institution's actions (with or without partnership) that contribute to a more just and sustainable society, considering jobs, actions, activities, projects and programs developed aimed at the community, aiming at social inclusion, economic development and improving the quality of life and local infrastructure (Brasil / MEC / Inep, 2017, p. 41). Perceives the USR, still in the form of isolated actions and projects, which can be in partnerships, which leads to understand, that exempts the HEIs responsibility in assuming their commitment to the community. In addition to not being treated in a transversal way, which should go from the pedagogical project to the physical structure of HEIs. The government ends up contributing to the opening of Institutions that do not have adequate physical conditions for their buildings, which could be more sustainable, such as solar lighting or other types, or even the reuse of water and so many other measures that could not impact the environment;

When analyzing the “assessment instrument for On-Campus and Distance Undergraduate **Courses**”, it was found that the dimension and indicators in which USR is cited reaching the following conclusions:

- The USR is mentioned only in dimension 1, called “Pedagogical Didactic Organization”, and only in indicator 1.5, which deals with Curricular Contents, where environmental education, human rights education and education of ethnic-racial relations and the teaching of Afro-Brazilian, African and indigenous history and culture that are in line with Art. 3rd Section III of Law No. 10,861, of April 14, 2004, which institutes the National Higher Education Assessment System - *SINAES*, but loose and scattered.
- The other indicators of dimension 1, “Didactic-Pedagogical Organization”, deal with innovation to have a concept 5, but do not refer to the transversal process, with an omission in the evaluation instrument;
- The instrument does not mention the term University Social Responsibility at any time, with a lack of commitment on the part of the bodies that regulate the process of opening and evaluating the courses of an HEI;
- In dimensions 2 and 3, which deal successively with that of the Faculty and Tutorial and the infrastructure, there is no requirement for projects and research related to the theme, much less to make sustainable demands regarding the infrastructure of an HEI

In addition to the above assessment instruments, it is necessary to analyze Opinion no. 6082018-10-03 / CNE / CES which is approved by Ordinance No. 1,350 / MEC of 17/12, published in the *D.O.U.* of 12/17/2018, which establishes the Guidelines for Extension in Brazilian Higher Education, where 10%

of the workload must be included in the curriculum matrix, and must comprise the MEC assessment instruments. In this opinion, social responsibilities are mentioned as follows:

The principle of **social transformation** reaffirms extension action as the mechanism through which the higher education institution is interrelated with other **sectors of society**, with a view to a transforming performance, focused on the interests and needs of the majority of the population. population and promotes **social and regional development, as well as for the improvement of public policies.**

In order to promote transformative interaction between higher education institutions and other sectors of society, through the production and application of knowledge, the extension will have as principles:

- a) Contribution to the integral education of the student, stimulating his education as a critical and responsible citizen;
- b) The establishment of constructive and transformative dialogue with the other sectors of Brazilian and international society, respecting and promoting interculturality;
- c) The **promotion of initiatives** that express **the social commitment of higher education institutions** with all areas, especially those of communication, culture, human rights and justice, education, environment, health, technology, production and work, in line with with policies linked to guidelines for environmental education, ethnic-racial education, human rights and indigenous education;
- d) Promotion of ethical reflection regarding the social dimension of teaching and research;
- e) Encouraging the **performance of the academic and technical community** and their **contribution to facing the issues of Brazilian society**, including through economic, social and cultural development;
- f) Support for ethical principles that express the social commitment of each higher education institution;
- g) Performance in the production and construction of knowledge, updated and consistent with the Brazilian reality, focused on social, equitable and sustainable development. (Opinion n. 608-2018-10-03 / CNE / CES emphasis added).

The legislation dealing with University Extension establishes that there must be interaction between the university and the community, towards a cross-cutting institutionalization to permeate all dimensions of an institution, demanding from an infrastructure, from its buildings, in sustainable ways without aggression in the environment, as well as in a management vision, being an organizational culture, and not just isolated actions and projects.

In addition, when crossing the extension legislation, with the evaluation instrument, used to authorize undergraduate courses, it was found that the extension became part of the course matrix. However, it appears that the extension is mentioned only in Indicator 1.1, which deals with institutional policies within the scope of the course, where it informs:

The institutional policies for teaching, extension and research (when applicable), contained in the PDI, are foreseen within the scope of the course and clearly aimed at promoting learning opportunities aligned with the profile of the graduate, assuming successful or innovative practices for its review (Brasil / MEC / Inep, 2017, p.11).

In addition to the control instruments above, there are other evaluations where Inep (National Institute of Educational Studies and Research Anísio Teixeira Legislation and Documents), disclose the quality indicators of the HEIs, which are ENADE (National Student Performance Exam), the CPC, (preliminary concept of course) and the IGC (General Course Index), but which are the result of a composition of the Superior Census, which will not be part of the analysis of this article, and should be part of future research.

## **5. Conclusion**

The research focused on the assessment instruments in loco for the opening of HEIs and their courses. It was intended here to show, from a systemic view, that society must have knowledge, to be able to make new demands for education, and not only become a business, but that can transform people and these people can transform the world.

Thus, there is an inefficiency of the Government's control mechanisms, in relation to private Higher Education Institutions, and as much as it is understood that RSU cannot be carried out only by a legal requirement, but rather, be an ethical commitment by corporations. , laws are necessary to regulate the educational practices of an institution, and what has happened is an omission of the legislation towards society.

In the evaluation process, the acts that regulate higher education, are inseparable from the act of educating, and it must be in a responsible manner, with all the actors involved, including the government, the responsibility for a more just, sustainable and egalitarian society, because when there are no requirements in the instruments that legalize the business, companies end up carrying out the minimum compliance required by law.

## **6. Acknowledgments**

To Postgraduate Department of the University of Fortaleza - PPGA, CE - Brazil.

## **7. References**

- Ashley, P. A. (Coord.). *Ética e responsabilidade social nos negócios*. São Paulo: Saraiva, 2004.
- Associação Brasileira de Mantenedoras de Ensino Superior. (2007). *Responsabilidade Social. Ensino Responsável* 2006. Relatório das atividades sociais realizadas pelas IES, 2018.
- Beck, Ulrich. *Sociedade de risco. Rumo a uma outra modernidade*. 2ª edição. São Paulo: Editora 34, 2011.
- Brasil. Lei nº 9.394, de 20 de dezembro de 1996, que estabelece as diretrizes e bases da educação nacional;
- Brasil Lei nº 10.861, de 14 de abril de 2004, que institui o Sistema Nacional de Avaliação da Educação Superior – SINAES;
- Brasil/CNE.. Resolução Nº 7, de 18 de dezembro de 2018, que estabelece as Diretrizes para a Extensão na Educação Superior Brasileira e regimenta o disposto na Meta 12.7 da Lei nº 13.005/2014, que aprova o Plano Nacional de Educação - PNE 2014-2024 e dá outras providências;

- Brasil. MEC. Portaria Normativa Nº 20, de 21 de dezembro de 2017, que dispõe sobre os procedimentos e o padrão decisório dos processos de credenciamento, credenciamento, autorização, reconhecimento e renovação de reconhecimento de cursos superiores, bem como seus aditamentos, nas modalidades presencial e a distância, das instituições de educação superior do sistema federal de ensino;
- Brasil. MEC Portaria Nº 23, de 21 de dezembro de 2017, dispõe sobre o fluxo dos processos de credenciamento e credenciamento de instituições de educação superior e de autorização, reconhecimento e renovação de reconhecimento de cursos superiores, bem como seus aditamentos;
- Brasil. MEC/Inep. Instrumento de avaliação de cursos de graduação presencial e a distância (autorização, reconhecimento e renovação de reconhecimento), 2017, Inep/MEC;. Brasil. MEC/Inep Instrumento de avaliação de cursos de graduação presencial e a distância (autorização, reconhecimento e renovação de reconhecimento, 2017, Inep/MEC.
- Brasil. Conselho Nacional de Educação. Parecer n. 608. Brasília, 2018-10-03.
- Carrol, A. B.; Schwartz M. S., Corporate social responsibility: A Three-Domain Approach. *Business Ethics Quarterly*, v. 13, no 4, pp. 503-530, October, 2003
- Fagundes, Gustavo. Educação Superior Comentada | A Responsabilidade Social das IES, Ano 2, n. 24, de 9 a 15 de setembro de 2014. Disponível em:  
<https://abmes.org.br/colunas/detalhe/1144/educacao-superior-comentada-a-responsabilidadesocial-das-ies->. Acesso em: 25/06/2020
- Galbraith, John Kenneth. A economia das fraudes inocentes. Verdades para o nosso tempo. São Paulo: Companhia das Letras, 2004.
- Gasparin, João Luiz. Uma didática para a pedagogia histórico-crítica. 2. ed. Campinas – SP: Autores Associados, 2003.
- Pereira, Raquel. R Responsabilidade Social na Universidade. *Revista Gerenciais*, São Paulo, v. 2, set. 2003, p. 113 – 125
- Piovesan, Armando; Temporini, Edméa Rita. Pesquisa exploratória: procedimento metodológico para o estudo de fatores humanos no campo da saúde pública. *Rev. Saúde Pública*, vol. 29 ano. 4 São Paulo Aug. 1995.
- Reis, A. L.; Bandos, M. F. C. A responsabilidade social de instituições de ensino superior: uma reflexão sistêmica tendo em vista o desenvolvimento. *Revista Gestão & Conhecimento*. edição especial, Nov/2012, Minas Gerais, PUC-Minas.
- Santos, Milton. Por uma outra globalização. Do pensamento único à consciência universal. Rio de Janeiro: Record. 2000.
- Vallaey, François. Responsabilidade social universitária: uma definição prudente e responsável. *Revista do Desenvolvimento Regional*. Faccat, Taquara/RS, v. 14, n. 2, jul./dez., 2017.
- Vallaey, François. Rumo à institucionalização de uma responsabilidade social universitária crítica e inovadora. In: ORSIES: Observatório da Responsabilidade Social e Instituições de Ensino Superior. Livro Verde sobre Responsabilidade Social e Instituições de Ensino Superior. Edição Press Forum, SA - Comunicação Social, 2018.



# **Digital Testing During the Pandemic Crisis: University Students' Opinions on Computer-based Tests**

**Jana Jaskova**

Assistant professor, Department of Foreign Languages, Faculty of Electrical Engineering and Communication, Brno University of Technology, Brno, Czech Republic

Email: jaskovaj@feec.vutbr.cz

## **Abstract**

*In 2020, the pandemic crisis caused by covid-19 led to some changes in global education. Consequently, primary and secondary schools as well as universities introduced distance learning in many countries all over the world. This situation mostly required, among other things, a new way of testing learners' knowledge and skills. The objectives of this paper are to reveal university students' opinions on computer-based tests in comparison with paper-and-pencil tests and to map their requirements concerning digital testing of English as a foreign language. The research sample includes 284 students of the Faculty of Business and Management, Brno University of Technology, Czech Republic. These students experienced online testing at home during the summer semester of 2019/20 as well as paper tests at school in the previous winter semester of the same academic year. Thereafter, they were asked to complete an anonymous online questionnaire. The results have shown that the learners were mostly satisfied with the introduction of online testing at home. However, if the electronic tests took place at school, not all of them would prefer this way of testing. Regarding tasks in digital tests, the learners gave priority to assignments based on multiple choice. Moreover, the respondents expressed their views on electronic devices and testing speaking skills on online platforms.*

**Keywords:** digital testing; English as a foreign language; online tests; pandemic crisis; university students

## **1. Introduction**

Recently, primary and secondary schools as well as universities in many countries around the world have been innovating their approaches to teaching and testing. This trend was accelerated in 2020, when the global pandemic crisis caused by covid-19 led to the closure of many schools and introduction of distance learning. This paper aims to fill a gap in the current literature concerning university students' opinions on online testing of English as a foreign language during the pandemic crisis.

From March to May 2020, a state of emergency was declared in the Czech Republic resulting in significant changes in education, which also affected universities. University students were not allowed to attend courses and distance learning was introduced instead. Later, only a limited number of learners was allowed to enter school buildings, so a lot of teachers decided to assess their students' knowledge with the help of

online tests. This article introduces readers to university students' views on distance testing of English as a foreign language.

## **2. Theoretical background**

Nowadays, university teachers can use e-learning platforms not only for the preparation of online tests, but also for uploading various teaching materials. The combination of online education materials with traditional classroom methods is called Blended Learning (BL). Ughade and Badre (2020) tried to determine Indian MBA students' perceptions of BL in terms of its suitability in higher education. They used a structured questionnaire which was completed by 75 respondents. The authors found out that 57% of the students considered BL to be more effective than traditional classroom teaching, 60% agreed that they were able to access the content anytime and anywhere, 71% were of the opinion that BL increased their interest in the subject and 64% of them thought that BL should be incorporated in higher education.

In the field of foreign language teaching, the implementation of BL was investigated by Muhtia and Sumardi (2018). The case study involved one lecturer and six students of a paragraph writing course at the English Education Department of a university in Indonesia. The techniques for collecting data included interviews, observations and document analysis. Ten BL activities, including five activities in face-to-face settings (lecturing, class discussion, pair/group work, teacher-student conferencing, portfolios) and five activities online (uploading materials, online quizzes, online writing assignments, displaying the assignments, online feedback), were identified in the course. In order to find out the extent to which the use of BL affected the paragraph writing performance of 27 students, their scores were analysed and the positive effect occurred. Therefore, BL seems to be beneficial in higher education.

E-assessment (EA), which is an assessment where all procedures should be carried out electronically, helps teachers correct exams and release marks in a short time. Altruwais et al. (2018) discuss the advantages of using EA in different domains: student, teacher, institution, and education aims. They claim that students prefer EA because they can have more control, immediate feedback, improved performance, friendly interfaces, increased motivation etc. On the other hand, EA saves teachers' time, helps them to improve the quality of feedback for students, enables them to track students' performance, allows them to find misconceptions, reduces their burden etc. Moreover, using EA decreases the cost of institution to assess students, as the time is reduced. Next, EA has its own security by not allowing copying questions, assists in reduction of cheating by providing different questions in different order, includes checking identification and password verification to ensure students' identity etc. Last but not least, it supports educational aims by high order thinking skills, has the ability to sort questions which helps to represent information in a simple and fast way or provides more accurate results than paper tests by adaptive testing. To sum up, electronic tests offer many advantages.

However, the question is whether students' results in these tests are comparable to paper tests, which was investigated by Boevé et al. (2015) in the Netherlands. Altogether 401 bachelor students were enrolled in

a biopsychology course, half of which was randomly assigned to take a digital midterm test while the other half took a digital final test. The students' performance in these multiple-choice question exams has shown that there was no significant difference in the mean-number of questions answered correctly between the computer-based and paper-based mode for both the midterm and final exam. Next, after completing the computer-based exam the students were invited to fill in a questionnaire on their experience with it. In this respect, there was a difference in how the questions were evaluated between the midterm and final exam – the learners were less able to concentrate in the midterm test. Overall, 50% of the students preferred the paper-based exam, 28% gave priority to the computer-based one, and 22% indicated that they did not have a preference for one mode over another.

Similarly, Washburn et al. (2017) evaluated students' performance and perceptions of electronic vs. paper multiple-choice tests in a veterinary physiology course at the Texas A&M University College of Veterinary Medicine and Biomedical Sciences. In total, 134 first-year veterinary students and 13 graduate students were randomly assigned into two groups and were given four exams throughout one semester – two on paper and two electronically. Surprisingly, the mean score for electronic examinations was significantly greater than for paper ones. Next, the students anonymously completed two surveys concerning their experiences – at the beginning and at the end of their study. However, the results show that 87% indicated that they preferred paper over electronic formats, so the students' attitudes to the format were not primarily determined by their results. Moreover, almost all learners participated in one focus group discussion of 12 students. When asked if they experienced additional anxiety before the test because it was electronic, 85% responded yes. Only 28% of the students reported no technical problems with their device or software, the rest mentioned problems with downloading the exam, long delays caused by waiting for it to open or freezing their device. Therefore, technical problems are probably an inevitable part of electronic testing.

In the area of language education, Alyahya and Almutairi (2019) measured the impact of implementing electronic tests on middle school students' academic achievement in Arabic language courses in Saudi Arabia. They used mixed research design with quantitative experimental approach based on two groups – experimental with an electronic test and control with a paper-and-pen test. The test included questions measuring various components – listening and reading comprehension, spelling, writing, linguistics, grammar and writing skills. The results have shown a positive effect of digital testing on the students' academic achievement, especially in 'linguistics' where this component had a significant impact. Next, a qualitative approach with semi-structured interviews was used in a focus group of 8–10 students to find out their views on electronic testing and some important suggestions have been identified. For example, the ability to review the answers and change them in the electronic test had a positive effect on the students while their stress at the beginning of the digital test begun to disappear over time.

The above-mentioned stress might lead to poor academic performance. Kolagari et al. (2018) aimed at the effect of computer-based tests on students' anxiety at Golestan University of Medical Sciences, Iran. The quasi-experimental study was conducted with 39 nursing students with the anxiety score under 128 on Spielberger's State-Trait Inventory. The learners were randomly allocated to computer-based and paper-

based test groups. Prior to the exam all students completed Sarason's Test Anxiety Scale. The results have shown that 47% of the computer test students and 29% of those in the paper test group experienced higher test anxiety. However, this difference was not statistically significant, which, according to the authors, could be caused by the students' skills in handling their mobiles, tablets or laptops.

In conclusion, the introduction of electronic tests might lead to students' higher stress level, however, their results should not be negatively affected. In general, students are not inclined to change paper tests to electronic testing, which may be caused by, among other things, potential technical problems. However, university students will probably have to get used to this method of testing, since the current trend in science and technology is heading for it. Pokrivcakova (2019) focuses on this trend and claims that the constant development of modern information and communication technologies leads to the possibility of applying artificial intelligence in foreign language learning, for example in the form of personalized learning materials, machine translation tools, writing assistants, chatbots, language learning software, intelligent tutoring systems and intelligent virtual reality. As a result, foreign language education is becoming more learner-centred, as students are able to make their own decisions and become more responsible for their work.

### **3. Research methodology**

The research was conducted in two English language courses, each lasting two semesters, at the Faculty of Business and Management, Brno University of Technology. The first course, called Business English I/II, was focused on teaching English for Specific Purposes (level B1+ according to CEFR) in bachelor's study programmes. The content of the second course, whose name was English Language B2 I/II, was English for General Purposes (level B2 according to CEFR). This course was aimed at the preparation of master's programmes students for the First Certificate in English.

In both courses, the students took paper-and-pencil tests at school in the winter semester of 2019/20 while online testing was introduced in LMS Moodle in the summer semester of the same academic year. These tests examined the learners' knowledge of grammar and vocabulary, as well as their listening and reading skills. Therefore, they had the opportunity to compare the same types of tests in two different forms. The students completed the online tests at home, which provided them with some benefits. However, they were also asked for their opinions on potential computer-based tests at school and their preferences concerning electronic testing.

The available selection of respondents was realised in the research – a total of 633 learners were asked to complete a questionnaire, namely 402 full-time bachelor students, 171 full-time master students and 60 part-time master students. Altogether 284 respondents filled in the questionnaire, so the return rate was 45%. In total, there were 162 full-time bachelor students (40% return), 99 full-time master students (58% return) and 23 part-time master students (38% return). The percentage distribution of the research sample is shown in Figure 1.

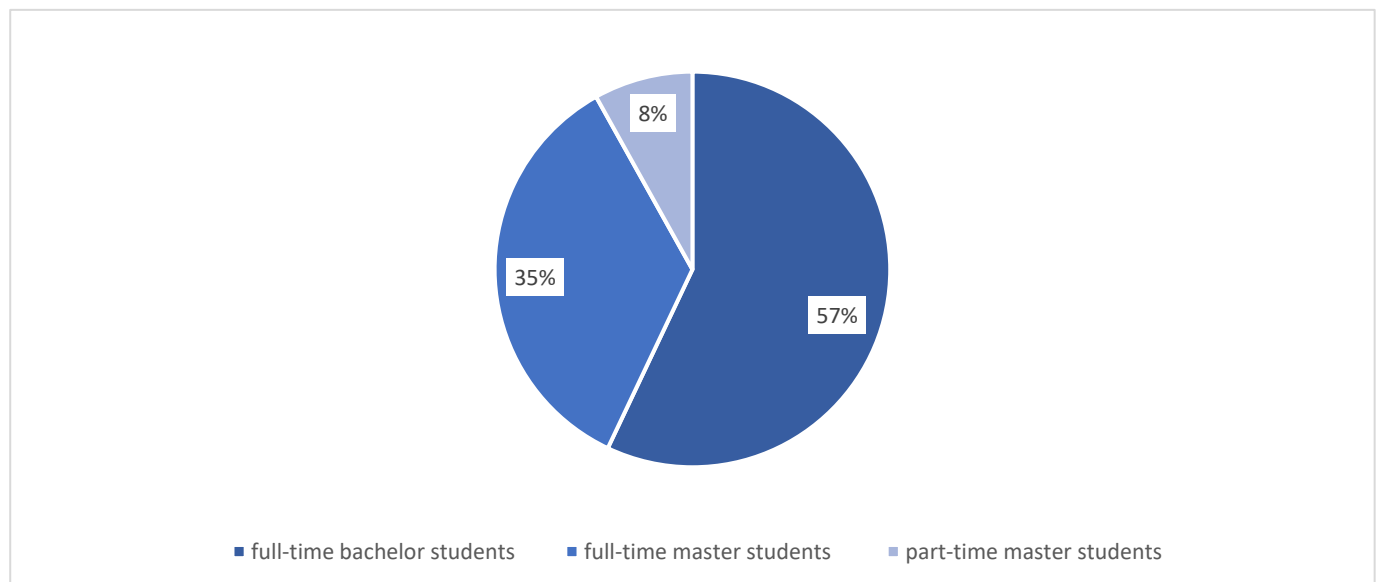


Figure 1. Research sample

As mentioned above, the aim of the research was to find out whether the university students preferred computer-based tests to paper-and-pencil tests and to map their requirements concerning digital testing in the English courses. Based on these objectives, a main research question has been created: *Do the students prefer computer testing to paper testing and what kind of online tests do they require?* This main question has been divided into several sub-questions:

- 1) *Were the students more satisfied with the paper-and-pencil tests taken at school or the computer-based tests taken at home?*
- 2) *Would the students be more satisfied with paper-and-pencil tests taken at school or computer-based tests taken at school?*
- 3) *Which electronic devices would the students choose for digital testing at school?*
- 4) *How were the students satisfied with the test tasks used in their online tests?*
- 5) *Would the students be satisfied with digital test tasks based on writing skills?*
- 6) *Would the students be satisfied with testing speaking skills via online platforms?*

The research method of questionnaire has been chosen to address the above-mentioned questions, since a lot of information could be obtained from a large sample of respondents with the help of the questionnaire (Gavora, 2012). In June 2020, the university students were asked by email to fill in the questionnaire published on [www.surveymonkey.com](http://www.surveymonkey.com). It consisted of eight questions (see Appendix). The first, factual question, was focused on the division of learners into the individual English courses.

The other six closed questions consisted of a scale of answers: *definitely yes – rather yes – don't know – rather no – definitely no*. These questions were based on the research sub-questions and each question had to be completed for three items:

- 1) *Were the computer tests which you took in the summer semester at home more convenient for you than the paper tests which you took in the winter semester at school? – Final Test, Listening, Reading*
- 2) *If the computer tests which you took in the summer semester were conducted at school, would they*

be more convenient for you than the paper tests at school? – Final Test, Listening, Reading

3) If you had to take the computer tests at school, would it be convenient for you to use the following devices? – Computer, Laptop, Tablet

4) Were you satisfied with the types of test tasks listed below that occurred in your computer tests? – True / False Choice, ABCD Multiple Choice, Text with Multiple Choice Words

5) Would you be satisfied if the test tasks listed below appeared in your computer tests? – Text with One Missing Word, Short Answer (1–5 Words), Long Answer (Several Sentences)

6) Would you be satisfied with the types of computer oral examination listed below which would be conducted in an online platform (e.g. Microsoft Teams, Skype, Zoom)? – Individual Speech, Conversation with a Classmate, Conversation with the Teacher

The last open question enabled the students to mention any comments and suggestions concerning the previous questions. This opportunity was taken by 42 students, which represents 15% of all the learners who completed the questionnaire. The validity of the questionnaire was increased by its anonymity, as anonymous questionnaires usually provide truer answers than non-anonymous (Gavara, 2000).

#### 4. Results and discussion

As the main research objective was to find out whether paper or computer tests were more suitable for the students, it would be appropriate to mention the learners' evaluation. Figure 2 shows the students' marks in both semesters and it is clear from it that they achieved significantly better results during computer testing in the summer semester. This was probably due to the fact that they sat for the tests at home, where they could use course materials or be in contact with other learners. Scientific literature also mentions better results in electronic tests (Alyahya & Almutairi, 2019; Washburn et al., 2017). However, this paper is about the comparison of results from two different tests (in the winter and summer semester) at two different places (at school and at home), so it cannot be compared to other authors' experimental research.

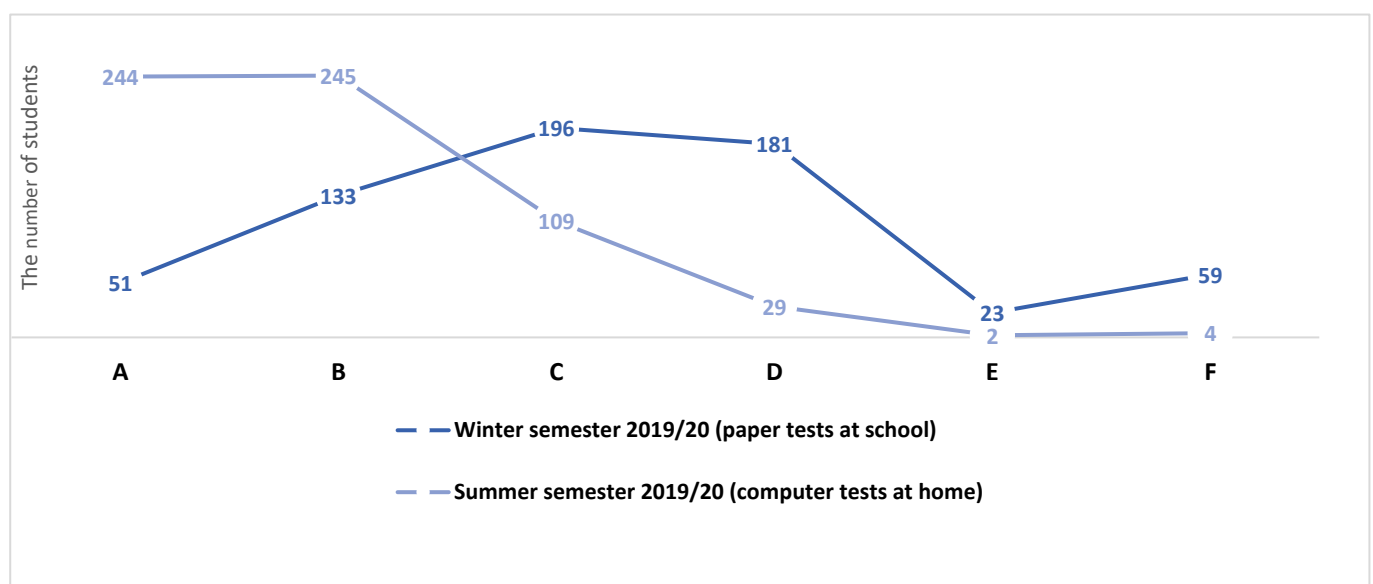


Figure 2. Students' evaluation



#### 4.1 Computer vs. paper tests

As already mentioned, two questions were aimed at comparing the respondents' satisfaction with paper and digital tests, both at home and at school. The students' answers were related to three types of tests – *Final Test*, *Listening*, *Reading*. The *Final Test* examined the learners' knowledge of grammar and vocabulary, where they had *ABCD Multiple Choice* answers. *Listening* and *Reading* tests, examining listening and reading skills, were slightly different in paper and electronic forms. Whereas the computer tests consisted of three types of test tasks (*True / False Choice*, *ABCD Multiple Choice*, *Text with Multiple Choice Words*), the paper tests used these assignments as well but also some other tasks which were not included into digital testing (filling missing words and phrases into listening transcripts, finding words and phrases according to their definitions in reading texts, adding sentences into reading texts, etc.).

In the first question, the respondents were asked if they had been more satisfied with the computer-based tests taken at home than with the school paper-and-pencil tests. Figure 3 shows that most students (89%) were satisfied with all computer tests, especially with *Listening*. Only some learners (8%) were against digital testing and a negligible number of them (3%) did not know. In the second question, the respondents were asked for their opinions on computer tests taken at school in comparison with paper tests. Figure 4 shows that their answers were substantially different. Although more students (54%) were for electronic testing, there was a significant number of learners (31%) who preferred paper tests, the rest of them (15%) did not know. The students were satisfied especially with the digital testing of *Listening*, a little less with *Final Test* and finally with *Reading*. Therefore, in both cases, most students gave priority to electronic tests. However, this is not consistent with other research (Boevé et al., 2015; Washburn et al., 2017) where most learners preferred paper tests.

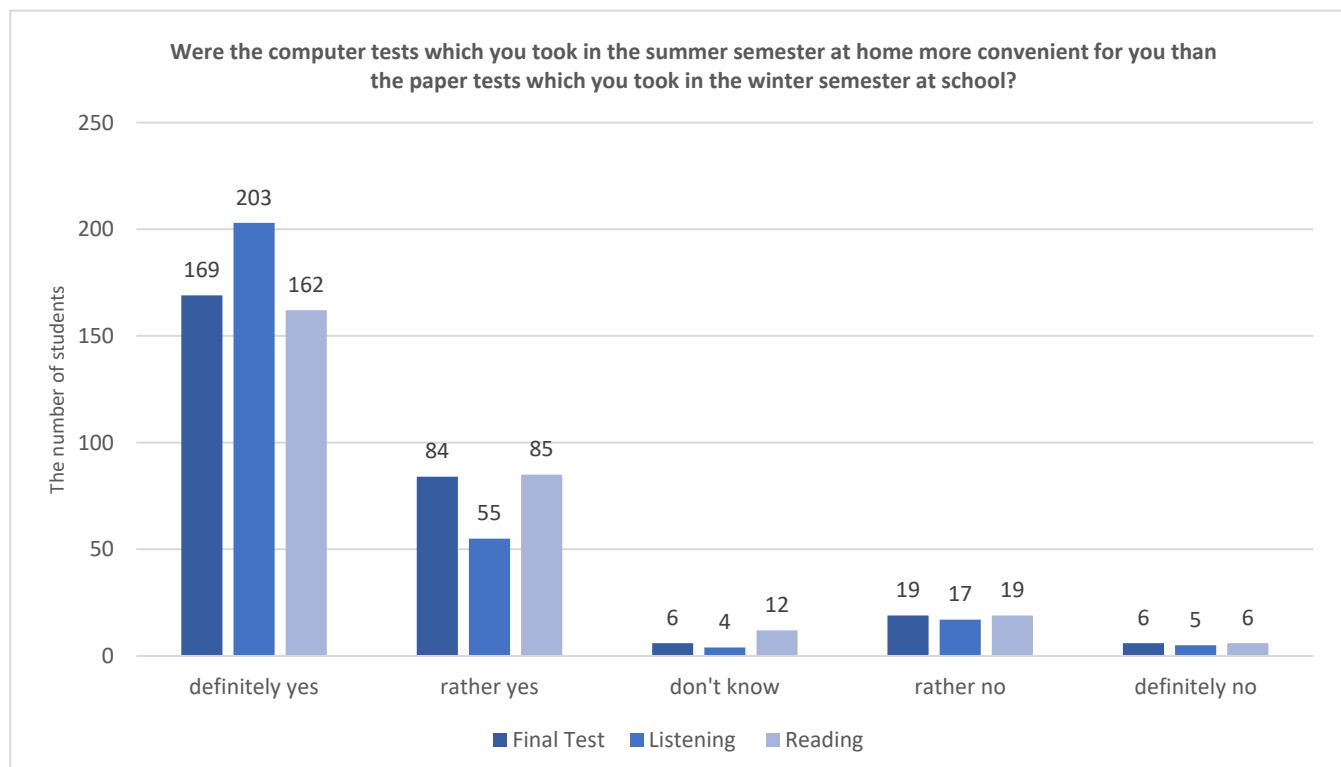


Figure 3. Students' opinions on computer tests taken at home



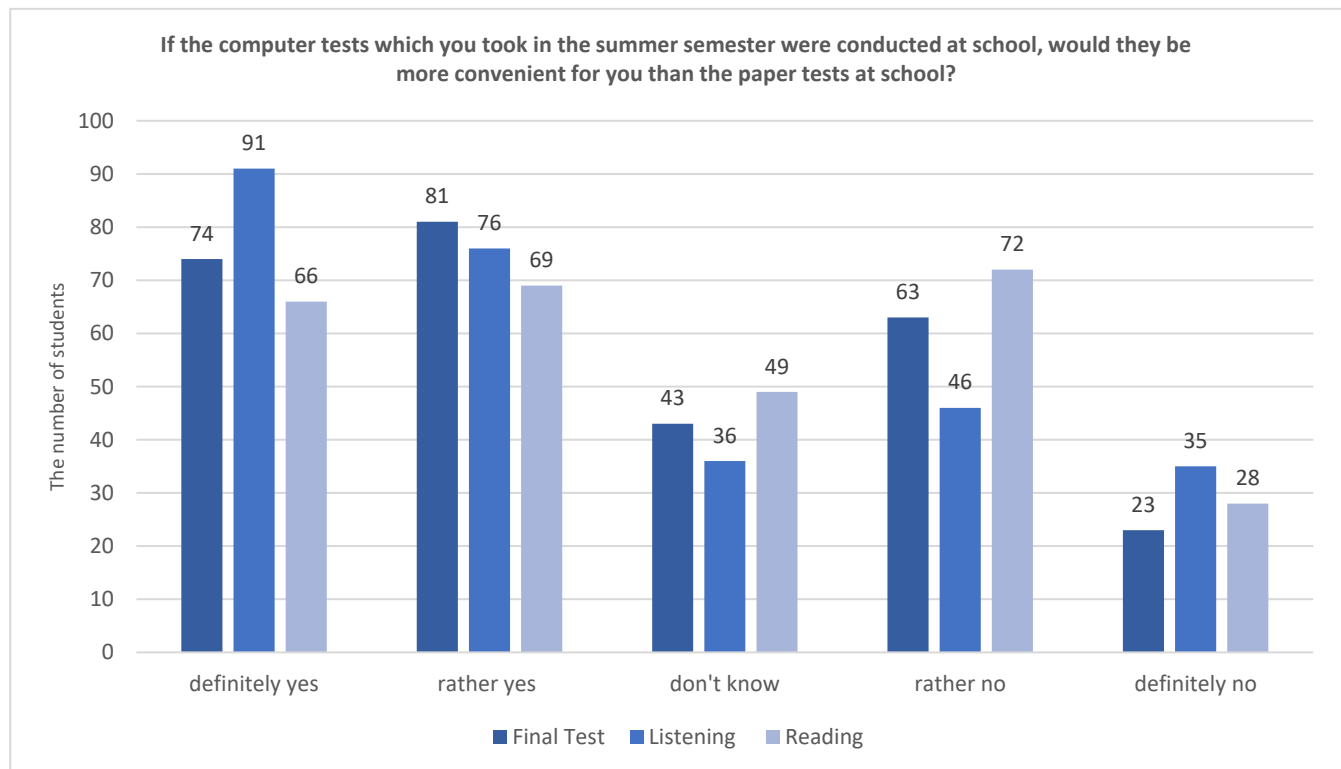


Figure 4: Students' opinions on computer tests taken at school

In the last, open question of the questionnaire, 5 respondents mentioned technical problems during *Final Test*. The test was mostly slowed down, or some students' websites crashed, which was caused by the fact that more than 400 learners joined it in LMS Moodle at the same time. Later, this problem was solved by taking online tests in a time range of several hours, but still having a limited time for the individual tests. Nevertheless, other 5 learners complained about technical problems concerning stopping and moving the recording during *Listening*. Moreover, 4 students mentioned some advice to prevent technical problems and the need to improve the way how to demonstrate possible technical failures. To sum up, technical problems might be common issues when implementing electronic testing (Washburn et al., 2017).

Regarding the content of the tests, 2 students mentioned that *Final Test* was not fundamentally different from its paper form and that they did not mind the digital form, a student asked for the possibility to have all questions on one page and 2 learners suggested that *ABCD Multiple Choice* should also include the option "no answer" because of deducting points for wrong answers. According to a large number of learners (16), the great popularity of online *Listening* (see Figures 3 and 4) lied in the possibility to stop and move the recording and to use their own headphones as opposed to school loudspeakers. Moreover, 3 students mentioned their dissatisfaction with scrolling up and down all questions in *Listening* and *Reading* since it was not possible to see the whole screen. A student mentioned that he would prefer a paper version in *Reading*, where he would be able to underline words and orient himself better in the text. This could result in less popularity of digital *Reading* in comparison with *Final Test* and *Listening* (see Figures 3 and 4).

On the whole, the respondents' preference for home electronic tests might be caused by the possibility of using school materials at home or comparing answers with other schoolmates. This was also mentioned by

a student: “Computer tests are useless. Try to compare the success rates of school and home tests. Students will always cheat in computer tests – this cannot be prevented in any way, unlike face-to-face tests.” However, stress factors at school could also play a role, which was mentioned by 3 learners: “I get a lot of stress from tests. There was no such stress at home, and I was able to concentrate better.” On the contrary, the stress factor has been studied by some authors (Alyahya & Almutairi, 2019; Kolagari et al., 2018; Washburn et al., 2017) who have come to the conclusion that electronic tests increase students’ anxiety more than paper tests. However, in this study the electronic tests took place in home environment, which, on the contrary, had a calming effect on the students. Moreover, 2 students noted the advantage of home testing because of the time saved by not travelling to the university.

#### 4.2 Equipment for digital testing

The intention of one question was to find out which equipment the respondents preferred to take online tests on. For this reason, three devices were selected – a computer, laptop and tablet. Figure 5 shows that most students gave preference to the computer (82%) and laptop (84%) – the answer *definitely yes* was mainly for the computer and *rather yes* for the laptop. Only a small number of the learners (11% and 12% in the same order) did not choose these devices while the rest of them did not know (7% and 4%). The situation was different with the tablet – as many as 68% of the students were against it and only 20% voted for it, while the remaining 12% could not decide.

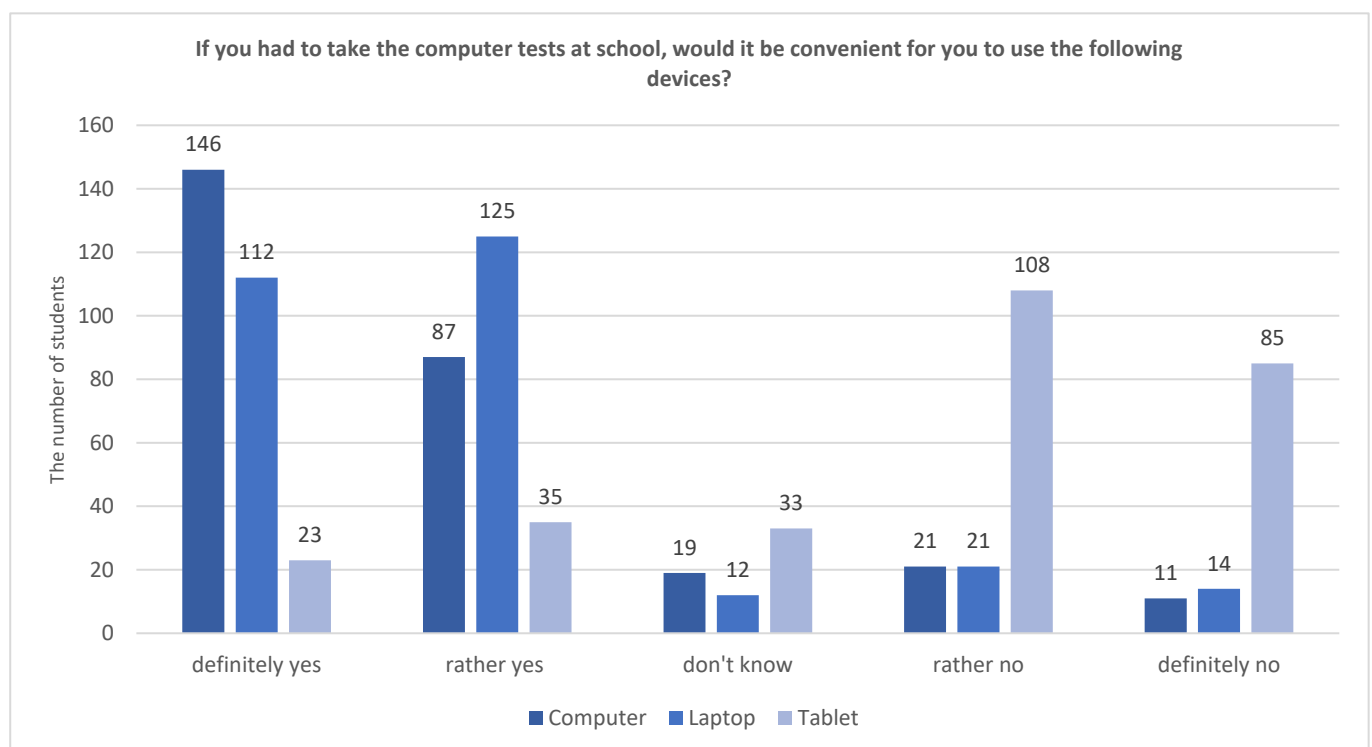


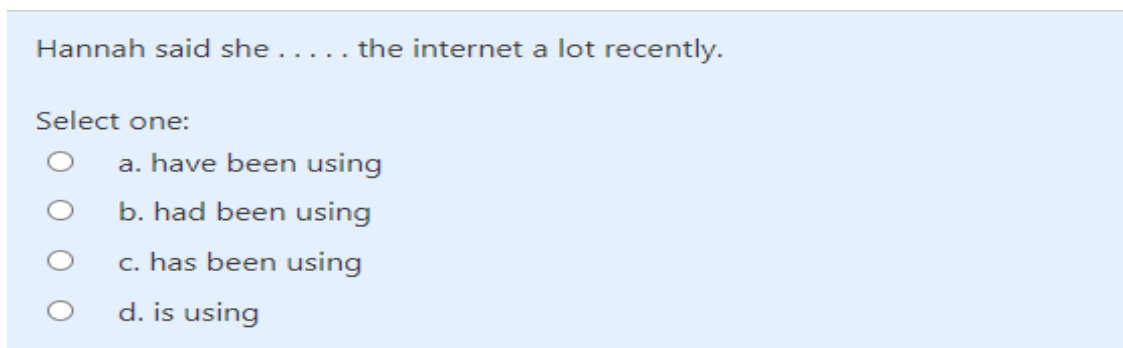
Figure 5. Devices for computer testing

Some respondents also mentioned their preferences concerning these devices in more detail. One of them noted: “An electronic version requires headphones, a good display (resolution, size), a physical keyboard and mouse/touchpad (therefore not a tablet) and the ability to write notes on paper.” Another student

mentioned his need to take school tests on his own laptop, and 2 students demanded the possibility to have their own headphones. While the latter would be a suitable and hygienic solution, it would not probably be possible to use the learners' own laptops because of the possibility of using the Internet or other materials in these devices.

#### 4.3 Types of test tasks

The purpose of one question was to find out how the respondents were satisfied with the test tasks used in their online tests. A task called *ABCD Multiple Choice* (Figure 6) was used not only for *Final Test* but also for *Listening* and *Reading*. In *Listening* there was also task *True / False Choice* (Figure 7) and in *Reading* task *Text with Multiple Choice Words* (Figure 8).

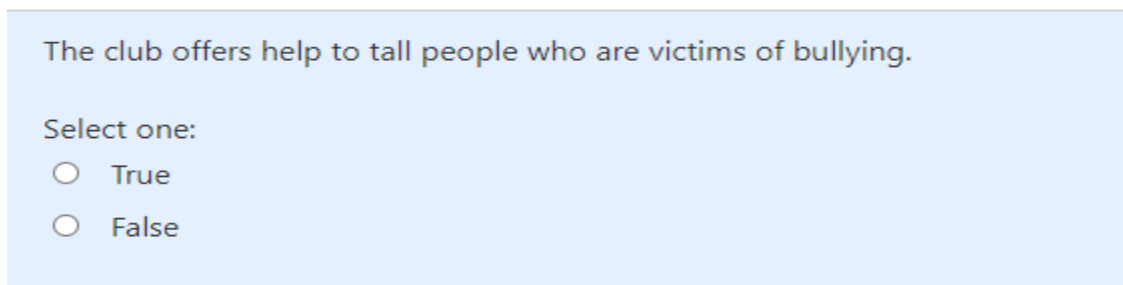


Hannah said she . . . . the internet a lot recently.

Select one:

- ☐ a. have been using
- ☐ b. had been using
- ☐ c. has been using
- ☐ d. is using

Figure 6. ABCD Multiple Choice

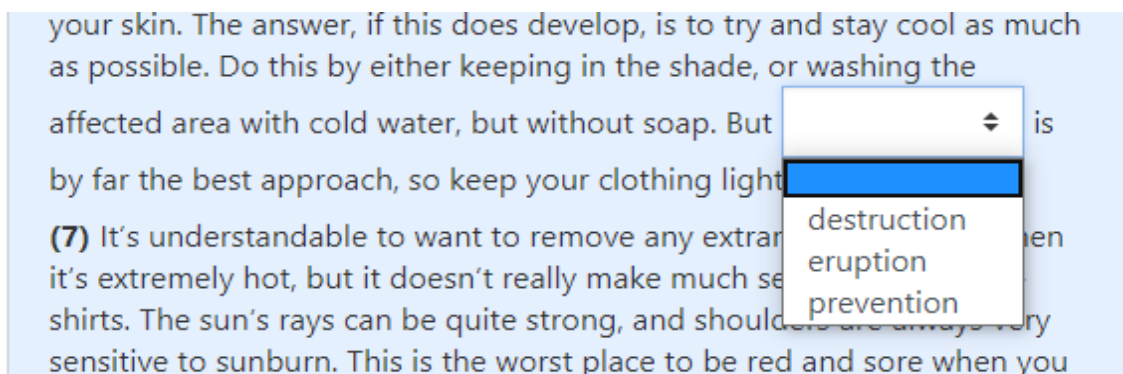


The club offers help to tall people who are victims of bullying.

Select one:

- ☐ True
- ☐ False

Figure 7. True / False Choice



your skin. The answer, if this does develop, is to try and stay cool as much as possible. Do this by either keeping in the shade, or washing the affected area with cold water, but without soap. But  is by far the best approach, so keep your clothing light

(7) It's understandable to want to remove any extra  when it's extremely hot, but it doesn't really make much sense. The sun's rays can be quite strong, and shoulders are always very sensitive to sunburn. This is the worst place to be red and sore when you

Figure 8. Text with Multiple Choice Words

Figure 9 shows that the students were mostly satisfied with all the mentioned test tasks. The most favourite

was *ABCD Multiple Choice* – 97% of the learners liked it and only 2% were against it. The students also expressed their satisfaction with *True / False Choice* (94%) where the number of dissatisfied learners was very low (5%). In both cases only 1% of students could not decide. The results for the last task called *Text with Multiple Choice Words* are not so explicit, as 71% of the learners voted for it, 22% were against it and 7% were not sure. The overall satisfaction with these types of tasks probably lay in their simplicity and unambiguity since the students did not have to invent their own answers.

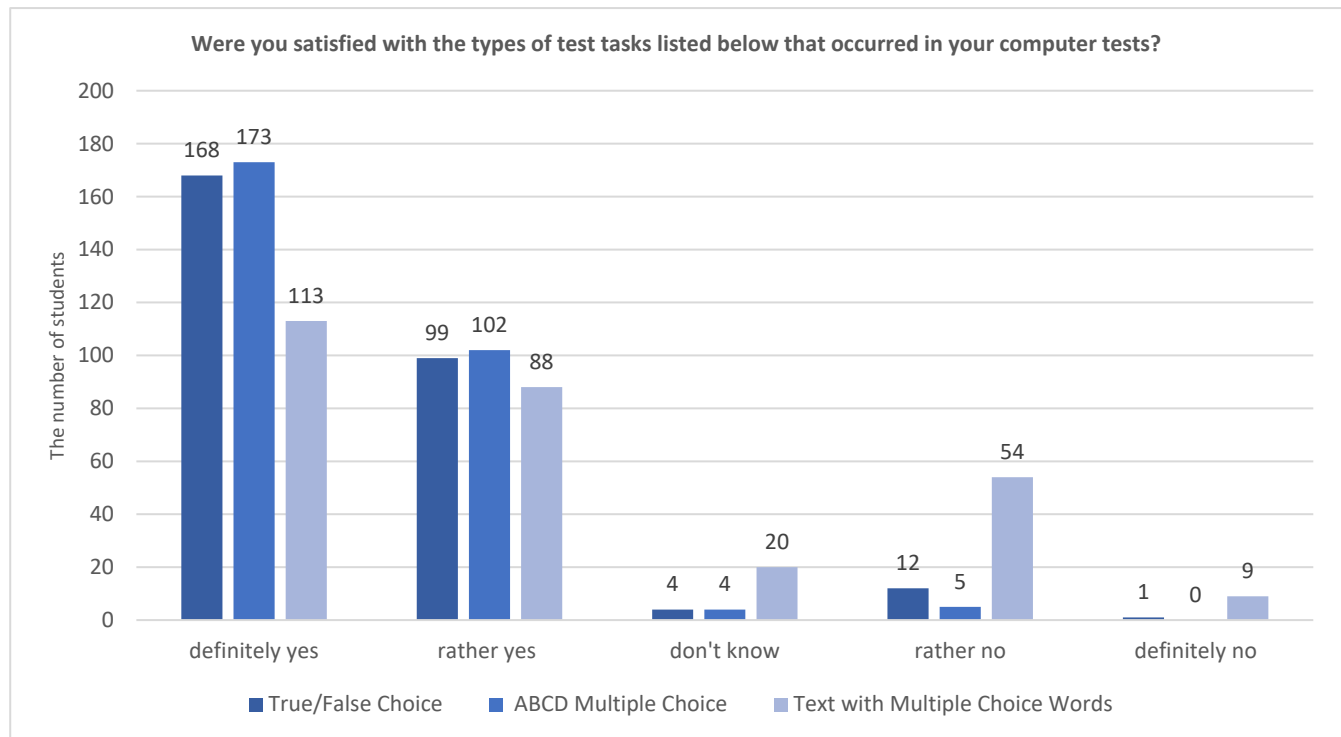


Figure 9. Students' opinions on multiple choice tasks

However, the respondents were asked not only about the tasks that had been included in their electronic tests, but also about others based on their own writing. Three types of tests were offered in the questionnaire – *Text with One Missing Word* (Figure 10), *Short Answer (1–5 Words)* (Figure 11) and *Long Answer (Several Sentences)* (Figure 12). The first two tasks had predefined answers, while the last task had to be corrected by a teacher in LMS Moodle.

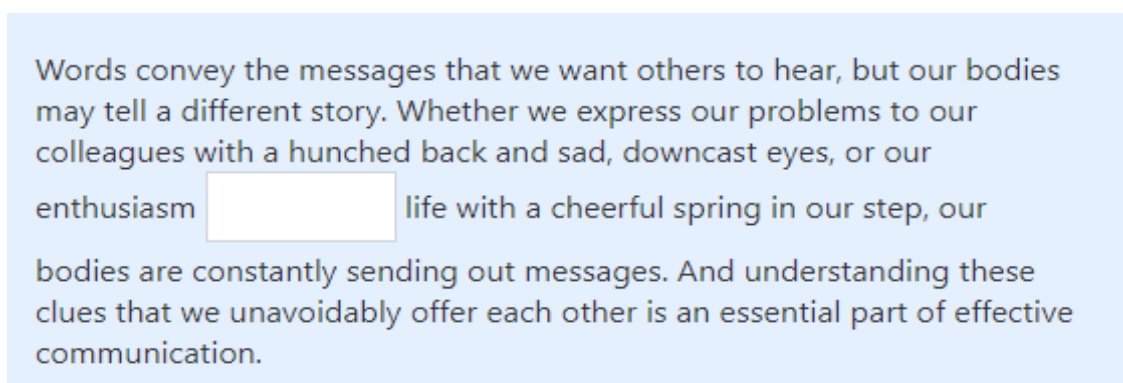


Figure 10. Text with One Missing Word

"People like me who can't hold their . . . . . for a very long can keep coming up for air."

Answer:

Figure 11. Short Answer (1–5 Words)

Everyone should have to wear smart clothes for work if they come into contact with members of the public. Do you agree?

↓

i ▼

🔥 ▼

🖌 ▼

B

I

☰

☷

🔗

🔄

🖼

Figure 12. Long Answer (Several Sentences)

According to Figure 13, these tasks were not very popular in comparison with the tasks based on the students' choice (see Figure 9). Only 64% of the students were for *Text with One Missing Word*, while 37% could imagine completing *Short Answer (1–5 Words)* and 13% *Long Answer (Several Sentences)*. It seems that the more words the learners would have to write, the lower their interest. Moreover, the students who were not satisfied with these tasks made up a significant number (26%, 51% and 77% in the same order), while 10%–12% of the learners could not decide.

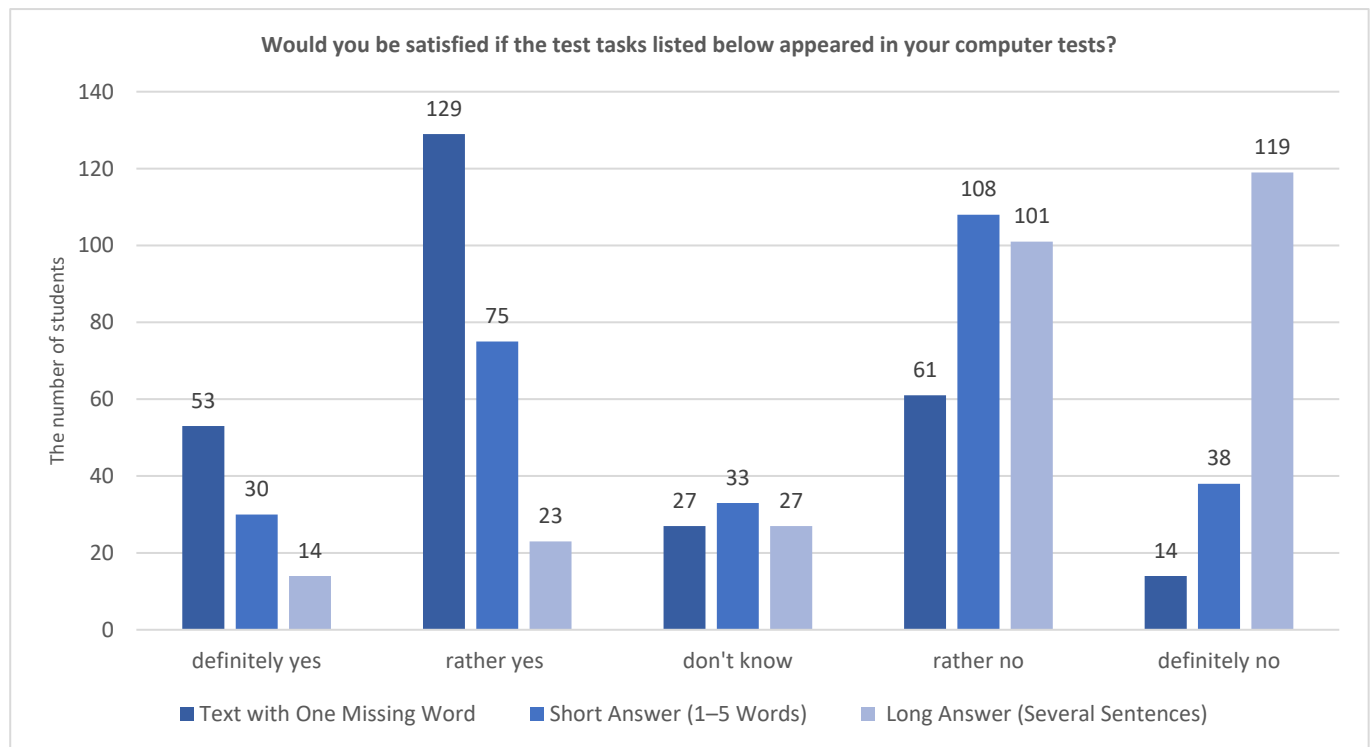


Figure 13. Students' opinions on writing tasks

Obviously, these tasks would be more difficult for the learners, which also 2 of them noted: "As for the longer questions in the test, I think that the tests would be more demanding, which would not be a problem if the student was allowed to answer the question in his own words." Similarly, 4 students were concerned with the idea that they might make mistakes in the predefined answers, which could be caused by typing errors.

#### 4.4 Testing speaking skills

In the field of foreign language knowledge (grammar, vocabulary) and skills (listening, reading, speaking, writing) the greatest importance of speaking skills has been mentioned by both students and employers (Dzieciol-Pedich, 2014; Hloušková, 2010; Jašková & Šťastná, 2019; Neuwirthová, 2009). Therefore, the aim of one question was to determine whether the students would welcome this type of testing on online platforms such as Microsoft Teams, Skype or Zoom. They were offered three options of testing their speaking skills – *Individual Speech* (e.g. talking about photos), *Conversation with a Classmate* (e.g. solving a problem) and *Conversation with the Teacher* (e.g. answering questions).

Figure 14 suggests that the respondents were not very enthusiastic about testing their speaking skills. Firstly, *Individual Speech* was chosen by 29%, while 55% were against it. As far as *Conversation with a Classmate* is concerned, altogether 35% of the students voted for it, but 48% rejected this task. The situation is slightly better with *Conversation with the Teacher* where almost half of the learners (44%) would not mind this way of testing, but also many students (39%) were against it. In all cases, there was a relatively large percentage of the learners (16%–17%) who were not able to answer this question.

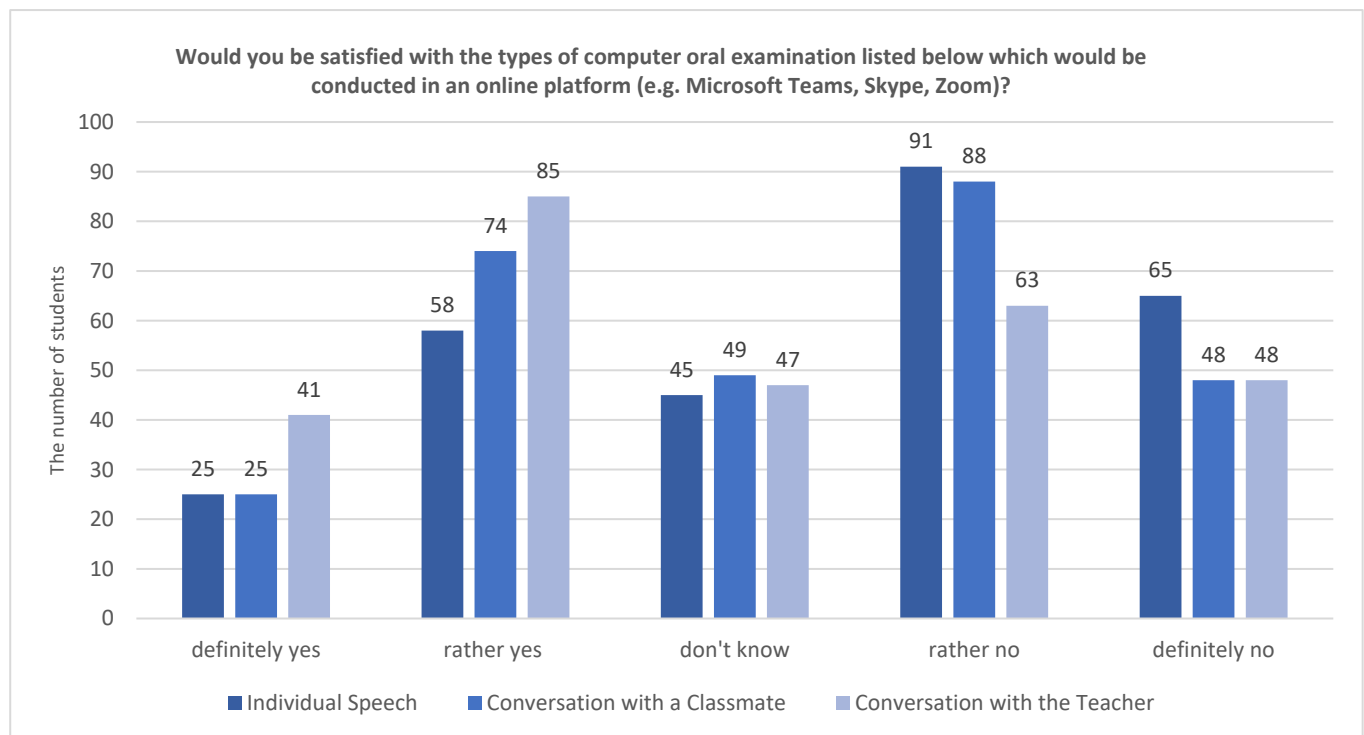


Figure 14. Students' opinions on speaking tasks

As for testing speaking skills, a student mentioned: "In my opinion, oral examination is the best way to test a student's knowledge of this subject.", while another learner noted: "For us students, it would certainly be a better way to test some conversation. It is much more practical, and I would say more useful for life." However, another learner admitted some negatives of oral examination: "From my own experience, I am not afraid to say that students are much more diffident at speaking than at the test form. But on the other hand, the spoken word is much more beneficial than the test – the spoken word is used much more often (mostly)." Only one student disagreed with this way of online testing: "Electronic testing bothers me a lot. I do not like the invasion of privacy, a student has to show his room, or simply the surroundings where he lives. For me, it is an extreme invasion to privacy." This opinion should be taken into account and solved in some way, for instance, by choosing an artificial background offered by a platform.

#### 4.5 Students' opinions on distance learning

As already mentioned, distance learning took place in the second half of the summer semester, when the students had various materials available in LMS Moodle (ppt presentations, textbook keys, recordings, mock tests etc.). At the end of the questionnaire, some students shared their views on this type of education as well. For example, a student mentioned his experience with this way of learning: "I also think that it would not be out of the question if these lessons took place only in an electronic way through e-learning, like Information Literacy." Another student noted that distance teaching could take place only during several weeks of a semester or as compensation for absences. A part-time student also requested video lectures on e-learning and praised distance testing: "For the part-time form, the distance exam with variable time is ideal and I am very much in favour of it in the future." However, teachers should realise that these students' opinions cannot be taken as dogma, as they might be driven by their desire to make their studies



easier.

## 5. Conclusion

In conclusion, the students were mostly satisfied with the online tests which they were allowed to take at home. However, they would not be so satisfied if they had to take these tests at school where they would prefer personal computers or laptops to tablets. As for the types of test tasks, they liked the tasks where they could choose the correct answer, while they mostly disliked written answers. Next, the students had different attitudes to oral examination on online platforms, considering conversation with a teacher to be the best way of testing speaking skills. These research findings provide insight into electronic testing from the learners' point of view, which might be useful in many universities where this way of English as a foreign language testing is being considered.

To sum up, computer-based testing is probably an inevitable future of foreign language teaching at universities. The tests themselves do not necessarily have to be based only on the choice of options, but also on written answers, so they can fully replace paper tests. Moreover, digital testing is useful especially in the assessment of a large number of students, where the biggest advantage is correction by software. The ideal situation would be if it was possible to take computer-based tests at school so that learners' knowledge could be objectively assessed. However, in the event of a pandemic crisis, the tests can also be taken at home, where it is not possible to prevent cheating. This problem should be solved in the future, for example by using special software to monitor students.

## 6. References

- Alruwais, N., Wills, G., & Wald, M. (2018). Advantages and challenges of using e-assessment. *International Journal of Information and Education Technology*, 8(1), 34–37. Available from <http://www.ijiet.org/vol8/1008-JR261.pdf>
- Alyahya, D. & Almutairi, N. (2019). The impact of electronic tests on students' performance assessment. *International Education Studies*, 12(5), 109–119. Available from [https://www.researchgate.net/publication/332738124\\_The\\_Impact\\_of\\_Electronic\\_Tests\\_on\\_Students'\\_Performance\\_Assessment](https://www.researchgate.net/publication/332738124_The_Impact_of_Electronic_Tests_on_Students'_Performance_Assessment)
- Boevé, A. J., Meijer, R. R., Albers, C. J., Beetsman, Y., & Bosker, R. J. (2015). Introducing computer-based testing in high-stakes exams in higher education: results of a field experiment. *PLoS ONE*, 10(12), 1–13. Available from <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0143616>
- Dziecol-Pedich, A. (2014). Business English in the eyes of economics and management students at the University of Białystok. *Studies in Logic, Grammar and Rhetoric*, 38(1), 83–102. Available from <https://content.sciendo.com/view/journals/slgr/38/1/article-p83.xml?lang=en>

Gavora, P. (2000). *Úvod do pedagogického výzkumu*. Brno: Paido.

Gavora, P. (2012). *Tvorba výskumného nástroja pre pedagogické bádanie*. Bratislava: Slovenské pedagogické nakladateľstvo.

Hloušková, J. (2010). *Analýza potrieb ve vyučování odborného anglického jazyka* [Needs analysis in teaching English for Specific Purposes]. (Doctoral dissertation). Faculty of Education, Palacký University Olomouc, Olomouc, Czech Republic. Available from [https://theses.cz/id/nzvbjn/Cela\\_prace\\_Hlouskova.pdf](https://theses.cz/id/nzvbjn/Cela_prace_Hlouskova.pdf)

Jašková, J. & Šťastná, D. (2019). Tertiary level proficiency in ESP: employer survey analysis. *CASALC Review*, 9(2), 5–20. Available from <https://journals.muni.cz/casalc-review/article/view/13375/11383>

Kolagari, S., Modanloo, M., Rahmati, R., Sabzi, Z., & Ataei, A. J. (2018). The effect of computer-based tests on nursing students' test anxiety: a quasi-experimental study. *Acta Informatica Medica*, 26(2), 115–118. Available from [https://www.researchgate.net/publication/325420118\\_The\\_Effect\\_of\\_Computer-based\\_Tests\\_on\\_Nursing\\_Students'\\_Test\\_Anxiety\\_a\\_Quasi-experimental\\_Study](https://www.researchgate.net/publication/325420118_The_Effect_of_Computer-based_Tests_on_Nursing_Students'_Test_Anxiety_a_Quasi-experimental_Study)

Muhtia, A. & Sumardi, S. (2018). Blended learning in a paragraph writing course: a case study. *International Journal of Language Teaching and Education*, 2(3), 216–226. Available from <https://online-journal.unja.ac.id/IJoLTE/article/view/5744>

Neuwirthová, L. (2009). *Standard cizojazyčného vzdelávání na vysoké škole technického zaměření* [Standard of foreign language education at a technical university]. Brno: Akademické nakladatelství CERM.

Pokrivcakova, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. *Journal of Language and Cultural Education*, 7(3), 135–153. Available from <https://content.sciendo.com/view/journals/jolace/7/3/article-p135.xml>

Ughade, P. & Badre, S. (2020). Blended learning – a study on student's perception about suitability of the framework for higher education. *The Online Journal of Distance Education and e-Learning*, 8(2), 72–79. Available from <https://www.tojdel.net/journals/tojdel/articles/v08i02/v08i02-01.pdf>

Washburn, S., Herman, J., & Steward, R. (2017). Evaluation of performance and perceptions of electronic vs. paper multiple-choice exams. *Advances in Physiology Education*, 41, 548–555. Available from <https://journals.physiology.org/doi/full/10.1152/advan.00138.2016>

## Appendix

### Appendix 1. Questionnaire

#### Questionnaire of Students' Opinions on Electronic Testing

The aim of the questionnaire is to find out whether students in English courses prefer a digital form of testing to paper tests and what their preferences concerning computer testing are. The questionnaire is anonymous, consists of 8 questions and takes about 5-10 minutes.

**1) I am a student of ... (select 1 option)**

Bachelor full-time study (courses HA1PZ, HA2PL)	
Master full-time study (courses AJ1B, AJ2B)	
Master part-time study (courses AJ1BK, AJ2BK)	
Others	

**2) Were the computer tests which you took in the summer semester at home more convenient for you than the paper tests which you took in the winter semester at school? (select 1 option for each type of test)**

	Definitely yes	Rather yes	Don't know	Rather no	Definitely no
Final Test					
Listening					
Reading					

**3) If the computer tests which you took in the summer semester were conducted at school, would they be more convenient for you than the paper tests at school? (select 1 option for each type of test)**

	Definitely yes	Rather yes	Don't know	Rather no	Definitely no
Final Test					
Listening					
Reading					

**4) If you had to take the computer tests at school, would it be convenient for you to use the following devices? (select 1 option for each device)**

	Definitely yes	Rather yes	Don't know	Rather no	Definitely no
Computer					
Laptop					
Tablet					

**5) Were you satisfied with the types of test tasks listed below that occurred in your computer tests? (select 1 option for each type of test task)**

	Definitely yes	Rather yes	Don't know	Rather no	Definitely no
True/False choice					

ABCD multiple choice					
Text with multiple choice words					

**6) Would you be satisfied if the test tasks listed below appeared in your computer tests?** (select 1 option for each type of test task)

	Definitely yes	Rather yes	Don't know	Rather no	Definitely no
Text with one missing word					
Short answer (1-5 words)					
Long answer (several sentences)					

**7) Would you be satisfied with the types of computer oral examination listed below which would be conducted in an online platform (e.g. Microsoft Teams, Skype, Zoom)?** (select 1 option for each type of oral exam)

	Definitely yes	Rather yes	Don't know	Rather no	Definitely no
Individual speech					
Conversation with a classmate					
Conversation with the teacher					

**8) If you have some comments, suggestions, etc. on any of the above questions, you can mention them here:**

Thank you very much for completing the questionnaire.

# **The Context of The Inclusion of Children with Autistic Spectrum Disorder in Early Childhood Education**

**Thelma Helena Costa Chahini (Corresponding author)**

Doutora em Educação com Pós-Doutorado em Educação Especial. Professora Associada da  
Universidade Federal do Maranhão, Campus Dom Delgado, Maranhão, Brasil.

ORCID: <https://orcid.org/0000-0001-9872-2228>

Email: [thelmachahini@hotmail.com](mailto:thelmachahini@hotmail.com)

**Isaac Pereira Viana**

Psicólogo. Mestre em Cultura e Sociedade pelo Programa de Pós-Graduação em Cultura e  
Sociedade da Universidade Federal do Maranhão, São Luís, Maranhão, Brasil

Email: [isaac\\_pviana@hotmail.com](mailto:isaac_pviana@hotmail.com)

## **Abstract**

*The Autism Spectrum Disorder (ASD) is a Neurodevelopment Disorder which involves a few deficits pertaining to social and communication skills, as well as repetitive and restrictive behaviors. Brazilian law nº 12.764 of 2012 guarantees and protects the rights of those with ASD. This study's main objective is to describe the process of inclusion of children with ASD in public institutions of Early Childhood Education in the city of São Luís, Maranhão state, based on the perception of family members and the staff from said institutions. An exploratory descriptive research with a qualitative approach was conducted in two Early Childhood Education institutions with attending ASD children. Participants were 4 family members of children with ASD and 16 staff members who worked with the ASD children in the institutions. After receiving the consolidated opinion from the Ethics Committee (CEP/CONEP/UFMA, Nº 2.891.951), data were collected through semi structured interviews consisting of two scripts: one for family members, and the other for staff. Results showed that although the majority of children with ASD were well treated and accepted by staff and other children without disabilities, there are still many barriers to overcome in the context of Inclusive Education in Early Childhood Education. Among these barriers are those caused by stigmas related to the disorder in question, as well as the fear and/or rejection by parents and other family members of the interaction between their non-disabled children and those with ASD. Most people working with ASD children still feel unprepared. There is a lack of partnership between the studied institutions and the family members of children with ASD, which leads to another barrier to their inclusion in Early Childhood Education.*

**Keywords:** children with ASD; early childhood education; social attitudes; inclusion

## **1. Introduction**

According to the American Psychiatry Association (APA) in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), the Autism Spectrum Disorder (ASD) is a Neurodevelopment Disorder. For someone to receive this diagnosis, they must show a few deficits regarding social and communication skills, as well as repetitive and restrictive behaviors (American Psychiatry Association [APA], 2013).

The National Curricular Guidelines on Early Childhood Education, in Articles nº 3, 4 and 5, state that:

The Early Childhood Education curriculum is conceived as a set of practices that aim to articulate the experiences and knowledge of children with the knowledge which makes up the cultural, artistic, environmental, scientific and technological heritage, as a way to promote the whole development of children aged between 0 and 5 years;

The pedagogical proposals of Early Childhood Education must consider that the child, the center of curricular planning, is a historical subject with rights, who, through its daily interactions, relationships and practices, builds its personal and collective identity, plays, imagines, desires, learns, experiments, recounts, questions and builds meanings about nature and society, producing culture;

First step of Basic Education, the Early Childhood Education is offered in daycares and pre-schools, which are characterized as institutional non-domestic spaces comprising public or private educational facilities, that educate and care for children aged between 0 and 5 years during daytime, either full-time or part-time, regulated and overseen by a competent entity of the education system, and are subject to social control. (Ministério da Educação, 2009, p.1).

Within this context, children education and care must be shared and complemented both by Early Childhood Education institutions and the children's families, who must in turn participate, dialog, be heard, respected and valued in their many forms of organization (Ministério da Educação, 2009). As for staff members who work with these children (teachers, caregivers, etc), it is expected, among other things, that they include in their practices "[...] the recognition of age specificities, of the child's individual and collective singularities, promoting interactions between children of the same age and children of different ages" (p.3).

Furthermore, there are laws guaranteeing the right for inclusion of disabled people in all educational spaces in Brazil, such as the National Policy on Special Education in the Perspective of Inclusive Education (2008), the National Policy on the Protection to the Rights of the Person with Autism Spectrum Disorder – Berenice Piana Law (2012), and the Brazilian Law for the Inclusion of Persons with Disabilities (2015).

For instance, according to the National Policy on Special Education in the Perspective of Inclusive Education, an Inclusive Education is a right guaranteed to all disabled students, and it requires that faculty and other staff members involved in the teaching-learning process are qualified in this education modality (Ministério da Educação, 2008).

Therefore, the main issue addressed in this study is how children with ASD are being included in public Early Childhood Education institutions in the city of São Luís/MA. Based on this question a hypothesis was raised: despite all legal apparatus supporting the academic inclusion of all children, there are still

barriers – mostly behavioral – hampering the effective inclusion of autistic children in Early Childhood Education in the city of São Luís/MA.

To answer the proposed research problem, the main objective of this study was to assess how the process of inclusion of children with ASD is being conducted in public Early Childhood Education institutions, in the city of São Luís/MA, based on the perception of children's families and the institutions' staff members.

## 2. Methodology

The study was carried out in two public Early Childhood Education institutions where ASD children were regularly enrolled in the city of São Luís, Maranhão state. An exploratory, descriptive, qualitative research was conducted with 20 participants. Among those who were interviewed, four were family members of children with ASD (three mothers and one grandmother) and 16 were staff working with these children in the studied institutions (15 faculty members and one caregiver), with ten participants belonging to school A and ten to school B.

To select interviewees, the researcher went to the Municipal Secretariat of Education (SEMED), where it was informed that there were currently 94 Early Childhood Education schools with children aged between three and five years in the city of São Luís. Among these, only 12 had students diagnosed with ASD regularly enrolled. Out of these 12 schools, two were selected as samples. The criterion adopted for this selection was non-probabilistic and by accessibility. According to Gil (2008), this type of criterion is adopted in exploratory studies with no statistical rigor.

After receiving the Consolidated Opinion of the Ethics Committee (CEP/CONEP/UFMA, N° 2.891.951), data were collected through semi-structured interviews, with questions pertaining to general ASD themes in the context of Inclusive Education. Semi-structured interviews enable the description and understanding of social phenomena, allowing for a conscious and active participation of the researcher during information collection (Triviños, 1987).

Aiming to preserve the participants' identities, these were identified as: F1, F2, F3 and F4 (family members of children with ASD); P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15 and P16 (staff of studied institutions). The children whose family members were interviewed were identified as C1, C2, C3 and C4 (table 1).

Table 1. below correlates each children whose family members were interviewed, the school where they are enrolled, their ASD level, age, gender, and the family member interviewed.

Child	School	ASD level	Age	Gender	Family member
C1	A	Mild (level 1)	3	Male	F4
C2	A	Mild (level 1)	4	Male	F3
C3	B	Severe (level 3)	5	Male	F1
C4	B	Mild (level 1)	5	Male	F2



Table 2 below correlates each interviewed staff member with the school where it works, its age, educational background, specialization (whenever suitable), occupation, period of experience working with children with ASD, and gender. It is important to highlight that correlating the children with the staff members interviewed was not possible, since some of them had not worked with any of the children – they had worked with ASD children in other institutions, or even children that did not attend the studied institutions anymore –, while others had already worked with the children, but not in the occasion when interviews were carried out.

Table 2. Professor's data

Staff member	School	Age	Educational background	Specialty	Occupation	Period of experience with children with ASD	Gender
P1	B	48	Pedagogy (ongoing)	None	Teacher	3 years	Female
P2	B	62	Pedagogy	None	Teacher	2 years	Female
P3	B	34	Pedagogy	None	Teacher	3 years	Female
P4	B	41	Pedagogy (ongoing)	None	Teacher	1 year	Female
P5	B	53	Linguistics	None	Teacher	4 years	Female
P6	B	45	Pedagogy	None	Teacher	1 year	Female
P7	B	49	Accounting	Public accounting	Caregiver	1 year and 5 months	Female
P8	B	48	Pedagogy	None	Teacher	5 years	Female
P9	A	34	Pedagogy	None	Teacher	8 years	Female
P10	A	34	Pedagogy	None	Teacher	1 year	Female
P11	A	40	Pedagogy	None	Teacher	1 year	Female
P12	A	32	Pedagogy	Neuropsychology	Teacher	2 years	Female
P13	A	39	Biology and Pedagogy	None	Teacher	4 years	Female
P14	A	45	Pedagogy	Inclusive Education	Teacher	10 years	Female
P15	A	40	Pedagogy	None	Teacher	10 years	Female
P16	A	37	Pedagogy	None	Teacher	1 year	Female

Procedures were carried out taking into consideration the ethical criteria involving human beings. All participants signed an Informed Consent Form, agreeing to their participation and are aware that results would be published in scientific journals and events.

### 3. Results and discussion

Data obtained through interviews are presented here. When asked **what they understood about the Autism Spectrum Disorder**, 60% of interviewees responded within the scientific criterion for ASD diagnosis – or got close to this criterion by citing at least one of the characteristics of ASD included in the DSM-V. On the other hand, 40% of participants responded within common sense, i.e., they did not cite any of the ASD characteristics found in the DSM-V.

It should be noted that among the participants who responded to the question above within the DSM-V scientific criterion, or at least close to it, 11 were staff members and one was a family member. It is also important to highlight that participants P11 and P15 referred to ASD under the name of Global Development Delay. Although this term is in disuse according to the DSM-V, in the context of this research it was considered to be close to the scientific criterion, since it refers to a nomenclature used in the previous DSM edition, namely the DSM-IV.

Among the main aspects which according to the DSM-V can place a person within the ASD diagnosis, participants mentioned the difficulty in social interaction and communication; presenting stereotypical movements, and the classification levels: mild, moderate or severe, reflecting a reasonable understanding of what ASD is.

Among the participants who could not answer within the DSM-V scientific criterion – and not even close to it –, rather answering according to common sense, five were staff members and three were family members.

In general, a certain difficulty in identifying which type of disorder ASD is was noted, as well as its specificities, focusing on conceptions such as the *normal x abnormal* dualism, which does not in any way contribute to the inclusion of children with ASD, and even on stereotypes (Carvalho, 2006), agreeing with the thought of Amaral (1998) and being exemplified in one of the participants' statement: "These children are different from us, but with notions sometimes even better than that of a normal child" (p.13).

In this context, it is worth citing the National Policy on Special Education in the Perspective of Inclusive Education, as it emphasizes that staff members must have both an initial and continued education that covers from general teaching knowledge to the specific knowledge in the area of special education, as a way to establish an interdisciplinarity that creates conditions for several subjects (for instance, health and social assistance). They must also act collectively towards inclusion (Ministério da Educação, 2008).

It is known that staff with a certain level of scientific understanding regarding ASD – thus being capable of understanding and exemplifying some of its specificities, for example – may be in a better condition to favor the inclusion of children with ASD, while staff members that have no scientific understanding on this matter, at any level, may not be as fit to facilitate the inclusion of children with this disorder.

Furthermore, it is important to consider that social attitudes are also comprised of a cognitive aspect – besides the emotional and behavioral aspects – which is related to the level of knowledge individuals have about a certain social phenomenon. In this sense, Rodrigues, Assmar and Jablonski (2009) state that this cognitive aspect, when altered, may eventually modify the emotional and behavioral components of individuals, thus changing their own social attitudes in face of social phenomena.

Therefore, the importance of a correct understanding about ASD can be noted both by staff and family members, so that it generates favorable social attitudes to the inclusion of children with this disorder in Early Childhood Education.

Still on this matter, it is important to observe the results of the questions presented hereinafter, as they also cover the understanding staff and family members have about ASD and are therefore prone to the same discussion.

When asked **whether faculty and other staff members of the studied institutions were prepared for the inclusion of children with ASD in Early Childhood Education**, 40% of participants responded affirmatively and 60% responded the opposite, as they did not consider they were well prepared, albeit emphasizing that some of them still did whatever they could in favor of including children with ASD in Early Childhood Education.

As observed, the majority highlighted the lack of professional qualification in the context of Special/Inclusive Education. Therefore, data agree with what was found in the studies by Cabral and Marin (2017), Aguiar and Pondé (2017) and Ferreira (2017), when recognizing that staff members do not feel and/or are not ready to work with children with ASD. Cabral and Marin (2017) and Ferreira (2017) emphasize that this lack of training arises from the staff education itself, which is poor in the aspect of preparing them for inclusive practices.

Considering the exposed, it is observed that despite the existence of some public policies aiming at guaranteeing the training of staff members to work with disabled children, in practice, the majority of them do not feel and/or are not indeed ready for this job, pointing to a potential flaw in complying with the existing federal law in the inclusive education context.

It feels as if this flaw includes both the staff's initial and continued education, as observed in the following statements: "However, we do not get a lot of support in this sense. We do not have the support of the city hall itself. [...] we have a training in which we do not get a lot" (P3); "We do not receive training, not only by the Secretariat, but also by our professional training" (P12).

After being questioned about **whether there were barriers to the inclusion of children with ASD in Early Childhood Education institutions**, 85% of interviewees responded that there were; 10% did not know how to answer; and 5% stated that there were no barriers in the investigated context.

Among the interviewees who responded that there were barriers to the academic inclusion of children with ASD in Early Childhood Education, 14 were staff members and three were family members. The barriers mentioned include the lack of adequate teaching material; the lack of an adequate physical structure; the lack of a multidisciplinary team in schools; overcrowded classrooms; unprepared teachers due to a lack of adequate professional training and/or a lack of willingness; schools making the process of enrollment difficult; families that do not accept the child's condition, etc.

It is important to note that (P7) said there were no barriers, but right afterward contradicted itself by saying that there were no classrooms with multifunctional resources in the school it worked at, which characterizes a structural barrier.

In light of these facts, data go against what is assured by the National Policy on Special Education in the Perspective of Inclusive Education (Ministério da Educação, 2008), through the Berenice Piana Law (Lei nº 12.764/2012) and the Brazilian Law for the Inclusion of Persons with Disability (Lei nº 13.146/2015),

since, according to the current federal law, none of these barriers should exist. However, for most of the interviewees, there are barriers hampering the process of including children with ASD in Early Childhood Education, thus denoting a disagreement between the objectives of public policies targeting Inclusive Education and its operational purposes.

Regarding the gap between public policies and their operationalization, data agree with the results of studies by Chahini and Souza (2016), Luz, Gomes and Lira (2017), Ferreira (2017), Aguiar and Pondé (2017) and Cabral and Marin (2017), in which the authors identified barriers in the inclusion context and emphasized the need to overcome these obstacles so that Inclusive Education becomes a reality.

Participants who responded that there were no barriers to inclusion in Early Childhood Education said so based on their personal experiences, without entering into the specifics of how public policies have or have not been applied to Early Childhood Education, as observed in the following statements: “We never had. Everyone tries to help. Everyone works hard” (P8); “For now, since I am still new to this, I have not found any” (F1).

Based on these answers, determining to which point these personal experiences may be representative in the broader context of Early Childhood Education in other public schools of São Luís/MA does not seem possible.

After being asked about **how other children interacted with children with ASD in Early Childhood Education**, 65% of the interviewees said that children with ASD were accepted by others; 35% said that colleagues were sometimes afraid of children with ASD; that classmates used stereotypes when interacting; that the relationship between children with ASD and others without disability was not good due to the aggressiveness shown by some of the children with ASD, and that the classmates without disabilities retaliated; that children without ASD were not welcoming to those with the disorder.

As for statements describing the unfavorable attitudes regarding the acceptance of children with ASD by those without ASD, data agree with those of Brito (2017), when elucidating that when children with ASD were aggressive, they are under higher chances of not being accepted by their classmates, or even of receiving unfavorable social attitudes to their process of academic inclusion.

In this study, for example, it can be noted that in almost all occasions when staff and family members mentioned any unfavorable social attitude to the inclusion process, such as fear, they related it to the aggressiveness of the children with ASD, as seen in the following statements: “Suddenly, if he gets irritated with someone, he hits the child. And the child gets afraid of playing” (P5); “Even if he is part of the circle, everyone wants to sit faraway, because sometimes, all of a sudden, he would hit (P8); “[...] when I come here, I receive a lot of complaint about him hitting others” (F1); “Only in a few cases, when the child is hit by the autistic, it fights back” (P6).

Therefore, on the one hand, it is worth thinking about strategies that help children with ASD who behave aggressively in schools to reduce these behaviors. On the other hand, the school instrumentalization must be considered, as well as the students without ASD, so that they can deal with children with ASD more adequately when they present this type of behavior.

In summary, as for the two staff members who answered that children with ASD were accepted but overprotected by the other children, this is a good representation of what Amaral (1998) calls *victim stereotype*, in which the disabled person is seen as incapable of doing anything, even tasks they are able to

perform autonomously. In this case, it would be interesting that children are instructed to welcome children with ASD but taking care not to ignore their individual capabilities.

When asked about **how the parents and/or guardians of the children without ASD see the children with ASD in Early Childhood Education**, 40% said that parents of children without ASD accept those with ASD, as long as they are not aggressive towards their children and as long as they do not disturb the classroom, as seen in the following statements: “the parents understand, as long as the autistic does not “disturb” the activities in the classroom” (P11); “the parents see children with ASD as ‘sick’, ‘different’ and ‘incapable’” (P10). 30% answered that parents of children without ASD accept their children going to school with children with ASD, without restrictions.

Considering these facts, it is worth citing Brito (2017) when stating that aggressiveness represents a negative social contact, which tends to lead to unfavorable social attitudes to the process of inclusion of the child with ASD who displays this type of behavior. The more positive are the social contacts with the children with ASD, the more favorable social attitudes towards these children tend to be.

Regarding parents that do not accept the interaction of their children with others with ASD, the lack of knowledge about what ASD is prevails, as well as of the rights children with this disorder have of being a part of regular schools. This results in social attitudes that are unfavorable to the inclusion process of these children, as can be noted in the following statements: “Some of them do not like it, because they think their child will not learn, because the teacher will focus only on the autistic” (P14); “I have experienced this in a school. The parents got together and asked the school’s principal to move a child to another class” (P16); “She [mother] was complaining about her son going to school with an autistic child. I told her that, if she wanted she could take her child out of the school, because the other boy was not going to leave” (P15); “[...] there are those adverse opinions from who does not understand autism” (F2).

As for the staff member who said that parents accepted, as long as the child with ASD did not disturb the activities in the classroom, it is possible to notice what Amaral (1998) calls *villain stereotype*, in which the person with disability is seen as a troublemaker.

Participants also said that some parents complained their kid was “attacked” at school but when informed that the “aggressor” had ASD, they understood the situation, as seen in the following statements: “When they know an autistic hit another student, they get a little insecure, but we explain the situation and they are even sympathetic; they understand well” (P12); “[...] when they know about the situation, then that’s it, they understand it. All good” (P13).

These results agree with what (Omote, 2004; Campbell, 2006; Chambres et al., 2008) found, in a sense that when someone does not appear to have any disability, as is the case of someone with ASD, and behaves aggressively, they are under higher chances of receiving unfavorable social attitudes when compared to someone whose disability shows, and behaves in a similar way. However, when it is explained that, despite not showing, that person has a disability – thus causing the aggressive behaviors –, then positive social attitudes are seen, which favor the inclusion process.

#### 4. Conclusions

The proposed objective was to investigate how children with ASD are being included in public Early Childhood Education institutions in São Luís/MA, based on the perception of their families and staff members of the institutions. Among the universe of 94 public Early Childhood Education institutions in São Luís/MA, only 12 institutions had children – a total of 84 – diagnosed with ASD regularly enrolled, with 15 attending daycare facilities and 69 attending pre-schools.

In the two studied institutions, there were four children with ASD (one hundred per cent of the studied universe), two in school A and two in school B, with ages ranging between two and three years. Three children had mild autism (level 1) and one had severe autism (level 3). Eight staff members belonged to each school. Four family members of children with ASD participated (two from school A and two from school B): three mothers and one grandmother. In total, twenty interviewees participated in the study. The criterion used to select these participants was based on the universe of children with ASD from both schools. Most participants showed an adequate knowledge regarding Autism Spectrum Disorder – ASD. Although some of this knowledge is based upon common sense experiences, it shows understanding, awareness, and favorable social attitudes to the inclusion of autistic children and respect for human diversity.

On the characteristics of children with ASD, even amongst some *myths*, the ones most reported by participants were: difficulty in speaking, communication, social interaction, and visual contact; patterns of repetitive behaviors; restrictive interests; lack of autonomy in daily activities; stereotypical behaviors, etc. These characteristics are found in the academic literature, as well as in legislation. Therefore, this is considered favorable to the process of inclusion, as it assumes some level of adequate knowledge on their part in terms of the autistic people they work or have worked with, and this is an essential aspect for inclusion to happen.

In relation to the access of children with ASD to Early Childhood Education, most interviewees claimed they did not know children with this diagnosis outside of school, which is something positive for the academic inclusion, since these children have the right to not only being enrolled, but also to remain at school, interacting with other children and learning in their own pace, interest and capability. Lack of compliance to this right would represent the lack of academic inclusion itself.

As for the training of staff members to work with children with ASD in Early Childhood Education, most participants believed there was no training, mainly due to a lack of initial and continued adequate education to meet this demand. This result is alarming, considering all staff working with these children should be fully trained, according to the scientific literature and to the legislation itself. Therefore, the lack of training can hamper the process of inclusion.

Regarding the existence of barriers for the inclusion of children with ASD in Early Childhood Education, most interviewees stated that such barriers do exist. The main barriers mentioned were lack of adequate physical space, playful resources, adequate teaching material, staff training, and clarification for the families; the existence of unfavorable social attitudes to the process of inclusion by a few staff members; overcrowded classrooms, etc. According to the legislation and to the scientific literature, all these barriers should have been gone already, considering they hamper the process of academic inclusion.



On the matter of how children with ASD were treated by the staff members of the school they were enrolled in, most participants said they were treated well, “well” meaning children received: attention; care; love; hospitality; understanding. They were included in the social context; had their difficulties minimized; other classmates were aware of the condition of children with ASD, etc. This is a process considered favorable to the inclusion, since the acceptance, respect and interaction with differences assumes that inclusion is in fact happening, in compliance with the current legislation and with scientific studies in the area.

When asked about how children without ASD interacted with those with ASD, most interviewees claimed the latter were accepted by the former. This acceptance consisted in being called to play, interacting with others; being taken care by classmates; teachers receiving help to care for children with ASD, etc. These behaviors, in fact, denote acceptance and interest for the other, which are fundamental steps towards inclusion.

In regard to how parents/guardians of children without ASD dealt with the fact that children with ASD went to school with their children, most interviewees said they accepted, as long as their children were not assaulted. Indeed, the academic literature has pointed that aggressiveness hinders the inclusion process of children with ASD. With that in mind, it is important that the schools explain to parents of children without ASD about what it is. It is also essential for schools to learn how to deal with these aggressive behaviors in order to minimize them, thus favoring the inclusion process.

About the existence of partnership between family and school, most interviewees said that such partnership does exist. According to them, this collaboration occurs through: participation of families in the schools; families looking for specialized services, besides enrolling their children in regular schools; families adapting to the children’s needs, with staff members providing guidance; exchange of information between staff and family members regarding the child’s daily life both at home and at the school; sharing of information regarding the specialized services the children are subject to etc. It can thus be noted that the family participation is essential to the process of inclusion, as foreseen in both legislation and scientific findings.

Regarding what is missing for the school inclusion to happen, most interviewees stated that a bigger investment from the public authorities in this sector is lacking. According to these participants, improvements in the schools’ physical spaces are necessary; that teachers receive more support; resources, such as teaching materials; resource rooms in a few schools; more caregivers in classrooms; offering more training to staff members working in the schools; more public health staff to accompany children with ASD, facilitating issuing reports, for example, etc. Indeed, all these aspects, when lacking, are barriers to the inclusion. For inclusion to truly happen, these barriers must be brought down in conformity to the current legislation.

In regard to how staff members, see themselves in terms of training to work with children with ASD, most of them do not feel ready, mainly claiming deficits both in their initial and continued education. According to the law, these deficits should not exist, as all staff should have the opportunity to be fully trained.

As for how staff members, in particular, perceived the process of inclusion in the schools they worked at, they claimed children with ASD were welcomed, because according to them: the right for enrollment was respected; staff members mediated the social interaction with other children; participation was guaranteed in the same curricular activities as other children; there was partnership between the school and the family;



there was partnership between the school and health care workers; the teaching material was adapted; in one of the schools, a specialized educational service was provided in the resource room etc. It is interesting to highlight that most interviewed families agree to this perception by staff members. These characteristics do point favorably to the process of school inclusion, according to the legislation and to the theoretical scientific knowledge.

Regarding the age at which children with ASD enrolled in Early Childhood Education, the interviewed family members said that it was between ages two and three, which is favorable to the process of inclusion and complies to current legislation.

Considering these results, it is evident that most participants show adequate knowledge about ASD. Although children with ASD are treated well and accepted by the staff members and the non-disabled children in the studied institutions, several barriers still need to be overcome so that the Inclusive Education is effectively applied in Early Childhood Education. Among these barriers are those caused by stigmas related to the neurodevelopment disorder in question, and the fear and/or rejection of parents and other family members of non-disabled children in relation to the interaction between their children and the children with ASD; most staff members working with children with ASD still feel unprepared; there is a lack of partnership between the studied institutions and the families of children with ASD, leading to another barrier in the context of the inclusion of children with Autism Spectrum Disorder in Early Childhood Education.

Therefore, results from the present study corroborated the hypothesis raised, by highlighting that, despite the existence of a legal apparatus supporting the academic inclusion of all children, there are still barriers, mainly behavioral ones, hampering the effective inclusion of autistic children in Early Childhood Education.

## 5. References

- Aguiar, M. C. M., & Pondé, M. P. (2017). A exclusão na inclusão de crianças com transtorno do espectro autista em escola regular. *Revista Debates em Psiquiatria*, 7, 6-11.
- Amaral, L. A. (1998). Sobre crocodilos e avestruzes: falando de diferenças físicas, preconceitos e sua superação. In: L. A. Amaral. *Diferenças e preconceitos na escola: alternativas teóricas e práticas* (2ª ed.). São Paulo: Summus.
- American Psychiatry Association. (2013). *Diagnostic and Statistical Manual of Mental disorders - DSM-5* (5<sup>th</sup> ed.). Washington: American Psychiatric Association.
- Brito, M. C. (2017). Transtornos do espectro do autismo e educação inclusiva: análise de atitudes sociais de professores e alunos frente à inclusão. *Revista Educação Especial*, (59), 657-668.
- Cabral, C. S., Marin, A. H. (2017). Inclusão escolar de crianças com transtorno do espectro autista: uma revisão sistemática da literatura. *Educação em Revista*, 33, e142079.
- Campbell, J. M. (2006). Changing children's attitudes toward autism: a process of persuasive communication. *Journal of Developmental and Physical Disabilities*, 18(3), 251-272.
- Carvalho, R. E. (2006). *Educação inclusiva com os pingos nos "is"*. Porto Alegre: Mediação.
- Chahini, T. H. C., & Souza, A. Z. R. (2016, novembro 25-27). *Inclusão de crianças com deficiência na educação infantil* [Congresso]. Congresso Nacional de Educación Comparada, Sevilla, Espanha.

- Chambres, P., Auxiette, C., Vansingle, C., & Gil, S. (2008). Adult attitudes toward behaviors of a six-year-old boy with autism. *Journal of Autism and Developmental Disorders*, 38(1), 1320-1327.
- Ferreira, R. F. A. (2017). *Inclusão de crianças com transtorno do espectro autista na educação infantil: o desafio da formação de professoras* [Dissertação de Mestrado]. Universidade Federal de Minas Gerais.
- Lei nº 12.764, de 27 de dezembro de 2012. (2012, 27 de dezembro). Institui a Política Nacional de Proteção Dos Direitos da Pessoa Com Transtorno do Espectro Autista e Altera o Parágrafo 3 do Artigo 98 da Lei 8.112, de 11 de dezembro de 1990. *Diário Oficial da União*, seção 1. Recuperado em 29 de outubro, 2020, de [http://www.planalto.gov.br/ccivil\\_03/\\_ato2011-2014/2012/lei/112764.htm](http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/112764.htm).
- Lei nº 13.146, de 6 de julho de 2015. (2015, 7 de julho). Dispõe sobre a Lei Brasileira de Inclusão da Pessoa com Deficiência. *Diário Oficial da União*, seção 1. Recuperado em 29 de outubro, 2020, de [http://www.planalto.gov.br/ccivil\\_03/\\_ato2015-2018/2015/lei/113146.htm](http://www.planalto.gov.br/ccivil_03/_ato2015-2018/2015/lei/113146.htm).
- Luz, M. H. S., Gomes C. A., & Lira, A. (2017). Narrativas sobre a inclusão de uma criança autista: desafios à prática docente. *Educación*, 26(50), 123-142.
- Ministério da Educação. (2008). *Política Nacional de Educação Especial na perspectiva da Educação Inclusiva*. Brasília: Secretaria de Educação Especial. Recuperado em 29 de outubro, 2020, de <http://portal.mec.gov.br/arquivos/pdf/politicaeducspecial.pdf>.
- Ministério da Educação. (2009). Resolução CNE/CEB nº 05, de 17 de dezembro de 2009. (2009, 18 de dezembro). Fixa as Diretrizes Curriculares Nacionais para a Educação Infantil. *Diário Oficial da União*, seção 1. Recuperado em 29 de outubro, 2020, de [http://www.seduc.ro.gov.br/portal/legislacao/RESCNE005\\_2009.pdf](http://www.seduc.ro.gov.br/portal/legislacao/RESCNE005_2009.pdf).
- Omote, S. Estigma no tempo da inclusão. *Revista Brasileira de Educação Especial*, 10(3), 287-308.
- Rodrigues, A., Assmar, E. M. L., & Jablonski, B. (2009). *Psicologia social*. Petrópolis: Vozes.
- Triviños, A. N. S. (1987). *Introdução à pesquisa em ciências sociais: a pesquisa qualitativa em educação*. São Paulo: Atlas.

# **Use of wood waste from Amazonian tree species for the manufacture of products with regional identity**

**Geislayne Mendonça Silva**

UFCG

**Claudete Catanhede do Nascimento**

INPA

## **Abstract**

*Based on the problem of the quantity of wood waste generated by the timber milling process in sawmills in the state of Amazonas and the possibility of manufacturing products using this material, the aim of this study was to develop a product with regional identity made from this wood waste. The research process involved analysis of cultural issues in the North Region of Brazil and the quantity and quality of wood waste present in the Wood Engineering and Artefacts Laboratory (LEAM/INPA). This wood was donated by the company Mil Madeireira, located in the municipality of Itacoatiara in the state of Amazonas. Assessment of the regional themes of northern Brazil found that animals are represented in many products. This is especially true for handicrafts, where artisans seek to represent animals typical of the region in carvings, paintings, sewing and other crafts. As a result, a mood board was created with images of the most popular animals in the North region. The product was developed from hand drawings and 3D modeling to check the relationship between the pieces. Later, a physical prototype was developed using sawmill waste from the species Peãozinho (*Micrandropsis sclerorylum* W. Rodr), Cardeiro (*Scleronemoma micranthum*) and Mandioqueira (*Qualea paraenses*), after their classification. Based on the quality and quantity of waste generated from milling, one of the proposed alternatives was a coffee table called Arara (Macaw). The coffee table consists of 5 (five) pieces: 4 (four) of wood and 1 (one) of glass. In search of satisfactory results, this idea arose based on two factors: the aesthetic and emotional appeal, and modularity. The product was generated from analysis of elements of the northern Brazilian regional identity and the classification of waste from milling of certified wood and forestry residues. It has been observed that much of the wood is discarded or is burned to generate energy. In addition to the amount of wood wasted, two other factors were also analyzed: the first is the possibility of generating value through the culture of the northern region, specifically that of the state of Amazonas, through the manufacturing of products, and the second is to leverage the production of the wood industry. The product is easy to construct and the process can be taught to third parties, since the technical details are presented so as to facilitate its large-scale production.*

**Keywords:** Regional identity; Wood waste; Amazonian woods; Coffee table; Product design.

## **1. Introduction**

The Brazilian Amazon has a rich diversity in terms of fauna, flora and the culture of the people who inhabit it. Each state within the region has its own individual cultural heritage. This wealth of natural and cultural resources enables the development of a wide range of products. This is no different in the forestry sector, which considers timber production and the furniture and wooden products sector (MARCON *et al.* 2012). Despite being one of the activities of the most important productive sector in the northern Brazilian region, timber production in the Amazon presents several problems related to the processing of wood in terms of waste generation. As a result, a number of governmental and non-governmental initiatives have been created in order to try to contain the quantity of wood waste from timber milling in sawmills and woodworking workshops (MENDONZA *et al.* 2017, CAVALCANTI *et al.* 2003). According to Silva *et al.* (2019), "the use of wood residues from timber milling and naturally fallen trees is highly encouraged by research institutions, agencies and universities".

Although these actions exist, a significant amount of waste is still permitted by law, due to the fact that the National Environment Council - CONAMA approved the reduction of the percentage of log use in sawmills from 45% to 35%, measured by the Lumber Recovery Factor (CONAMA, 2016). This contributes to the devaluation of wood, as 65% of the wood material is lost, regardless of the species, commercial height, diameter of the trees and the quality of the wood material for final use.

The process of milling logs into lumber tends to focus on the heartwood of the trees. In most cases, the sapwood is not commercialized due to a lack of technological knowledge and is discarded in the sawmill yards as waste. In this regard, Lima *et al.* (2018) state that "it is apparent in many wood processing industries that there is technological deficiency in the maximization of the utilisation of logs". In addition to sapwood, several other types of wood waste are also discarded, such as cracked pieces, wooden ends, pieces that do not meet commercial dimensions and pieces with defects. In 2014, Brazil generated about 33.6 million tons of wood waste from forestry activities (BAUER & SELLITO, 2019).

A significant part of this waste is used for energy generation, mainly by burning in an internal boiler, sale to other companies, burning in brick kilns, use in poultry farms and for making briquettes (BAUER & SELLITO, 2019). In addition to energy generation, another use for wood waste is in the manufacture of products.

Generally, in the state Amazonas, most wood products are made by hand. In some cases, products made by artisans cannot be manufactured in series due to a lack of technical details. Another issue is that these artifacts are usually manufactured without the assistance of a designer, design technician or other similar professional, which would create a standard for the production of the artifacts.

Based on the problem described of the quantity of wood waste from timber milling and the devaluation of tree species from the Amazon, this study sought, in addition to the possibility of making products using this material, to develop a product (coffee table) with regional identity from wood waste.

## **2. Material and Methods**

In order to carry out the research, cultural factors in the North Region of Brazil were analyzed through a literature review. The quantity and quality of wood waste present in the Wood Engineering and Artifacts



Laboratory (LEAM/INPA), donated by the company Mil Madeireira, was also evaluated. The research was developed based on the methodology proposed by Barbosa Filho (2009), divided into seven stages:

1. Survey of demand
2. Construction of the concept
3. Creation of functional definition
4. Creation of alternatives
5. Materialization of alternatives
6. Testing and refinement
7. Presentation of final solution (Results)

### ***2.1 Survey of demand and construction of the concept***

Assessment of the regional themes of northern Brazil found that animals are represented in many products. This is especially true for handicrafts, where artisans seek to represent animals typical of the region in carvings, paintings, sewing and other formats.

Thus, a mood board (Figure 1) was drawn up with images of the most popular animals in the North region to help choose an animal that would contribute to the creation of a product with regional identity. The animal selected using a non-probabilistic sample was the Scarlet Macaw, due to its typicality and because it has the greatest variety of shapes and characteristics. The animals included in the mood board were: jaguar, scarlet macaw, caiman, capybara, Amazon turtle, anaconda, sloth, giant otter, boto (river dolphin), tamarin monkey and toucan (respectively, from left to right in Figure 1).



Figure 1: mood board.

## 2.2 Functional definition and creation of alternative

After the selection, stylised drawings of the animal were created in order to avoid reproducing carved representations, which usually aim to faithfully reproduce the shape of the animal or motif. Through this stylisation, the shapes of the macaw were smoothed out to create the table that is the object of this study. Other elements that are representative of the North region were also inserted during the creative process. These were the forest and the canoe, which is the most common means of transport in the municipalities of the region.

The three motifs: the selected animal, the forest and the canoe, were stylized so as to be incorporated into the shape of a coffee table. Based on the drawings, a cardboard model was generated to check the dimensions, angles and the relationship between the parts, as shown in Figure 2.

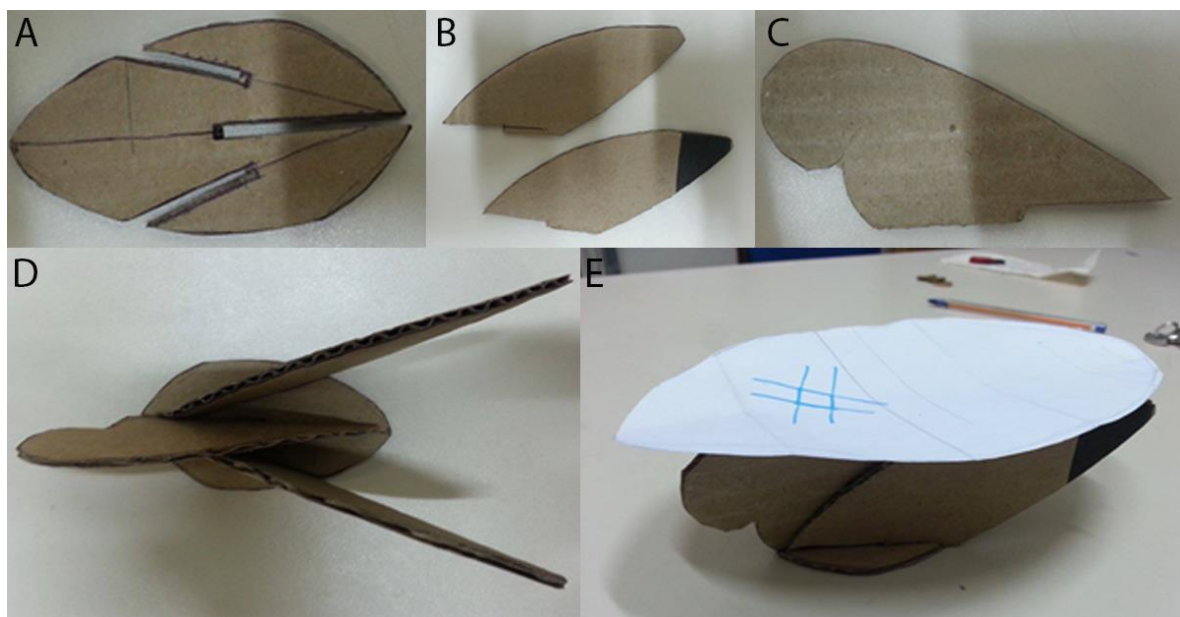


Figure 2. Cardboard model. (A) table base, (B) "wings", (C) "body", (D) assembly of parts, (E) verification of the complete model.

## 2.3 Materialization of the alternative and testing and refinement

Some adjustments were made after verification of the cardboard model and the measurements were established from a 1:1 scale drawing on a white board.

The coffee table was modeled in the CAD Solid Edge software in order to generate a virtual prototype. This avoids the need to make a physical prototype that would result in the use of materials and generation of waste. The virtual prototype (Figure 3) made it possible to check the dimensioning of the parts and the fit between them. This prototype was then used to draw up the technical details for manufacturing of the product.

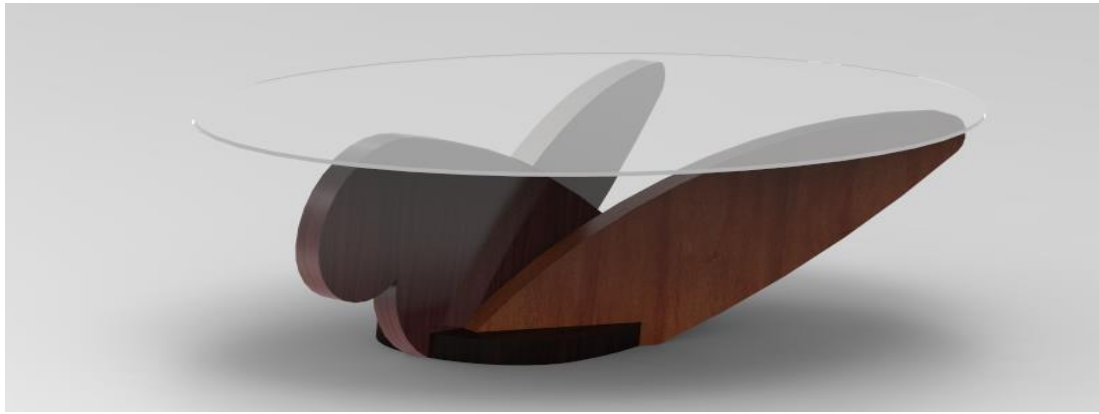


Figure 3. Virtual prototype.

A cardboard model with a 1:1 scale (Figure 4) was also developed for the glass top, which was later sent to a glass factory for fabrication.



Figure 4. Cardboard model of the glass top.

The wood residues from mechanical processing selected for making the table came from the following tree species: *Peãozinho* (*Micrandropsis sclerorylum* W. Rodr), *Cardeiro* (*Scleronemoma micranthum* Ducke.) and *Mandioqueira* (*Qualea paraenses* Ducke). The *Peãozinho* is a tree species that is not yet used in the logging chain, due to its small diameter.

The residues were measured and classified by size and by the quality of the wood, considering the heartwood and the sapwood of the *Peãozinho* due to their contrasting colors (Figure 5). Despite being visually distinct, both have similar properties and approximate densities, with the heartwood having a density of 0.93 g/cm<sup>3</sup>, and the sapwood having a density of 0.90 g/cm<sup>3</sup>. (BARROS, 2016)





Figure 5. Peãozinho Board.

After the classification and selection of the waste from the three tree species, the product was constructed using basic carpentry tools, e.g. a circular saw, band saw, thickness planer, calibrator, bench and orbital sander, and manual drill (Figure 6).



Figure 6. Making the Table.

#### 4. ANALYSIS OF THE RESULTS

The product was analyzed considering the volume of waste used, ease of manufacture, aesthetics, and ease of assembly and disassembly.

### 3. Results

The Amazon is rich in flora and fauna, and one of the most common species is the scarlet macaw. Therefore, the basic shapes that make up the table refer to the shape of this bird's body (body and two wings). The shape of the base is inspired by the shape of leaves, and the glass, which sits on top of the table, has a similar shape to the silhouette of a canoe seen from above, used as a means of transport by riverside dwellers (Figure 7).



Figure 7. Canoes.

We tried to work on all these elements in a single product, aiming to contribute to the valuing of regional identity through the use of shapes that refer to the Amazon rainforest and the culture of the people that inhabit it. The shape of the bird was chosen to further value the species of the region, showing that many elements can be taken advantage of, e.g. a bird, and even the canoe, which is the means of transport used by riverside dwellers. According to Bonsiepe (2011), this is one way to materialize the identity of a given location, in this case by exploring the regional theme and a group of formal characteristics.

The table was developed based on the quality and quantity of waste generated from timber milling. It consists of five pieces: four of wood and one of glass. In search of satisfactory results, this idea arose based

on two factors: the aesthetic and emotional appeal, and modularity.

The coffee tables' architecture is considered to be modular, because, according to Baxter (2011), modular architecture is that in which the blocks are arranged in modules and each module performs its function completely, containing well-defined and fundamental interactions. The application of this concept can also be seen in the work developed by Silva and Nascimento (2016). As such, the parts that make up the proposed table are independent modules, but which complement each other. This results in the formal configuration of the product. As for the modularity factor, we tried to work with joints alone, eliminating the use of any type of connecting element between the wooden pieces. However, during the fabrication of the product it became clear that two screws were needed to fix the parts together better.

Despite the organic shape, the pieces did not present any difficulties regarding the manufacturing process, as will be discussed later. It was necessary to use modularity for this piece to facilitate transport, as well as assembly and disassembly. Although the table will arrive at the final consumer in a disassembled form, they will then be able to assemble it without any specific knowledge.

The raw material used (wood) can come from forest residues (wood from naturally fallen trees in the forest), small diameter trees of species that are widely distributed in the Amazon forest according to the existing database in INPA's Forest Management Laboratory, and waste from timber milling. This follows the central concept of this product, which is to add value to Amazonian wood in its entirety, the wood of native species and the balance found in the relationship between nature, fauna and man through the use of this waste, which until now has been discarded or burned to generate energy.

### 3.1 The Arara (Macaw) coffee table

The waste came from certified wood that appears on the commercialisation list for the state of Amazonas. According to INPA/CPPF (1989), the tree species *Mandioqueira* and *Cardeiro* have good resistance and can be used for numerous products. The same also applies for *Peãozinho*, as researched by Barros (2016), table 1.

Table 1- Characteristics of the tree species used for making the table

Species	Density (g/cm <sup>3</sup> )	Workability	Uses
<b><i>Cardeiro</i></b> <sup>1</sup> <i>Scleronema micranthum</i> Ducke	0.59	Easy to saw, plain, nail and screw, receives a good finish	Carpentry, Joinery
<b><i>Mandioqueira</i></b> <sup>1</sup> <i>Qualea paraensis</i>	0.66	Easy to saw, plain, nail and screw, receives a moderate finish	Heavy construction, joinery and carpentry,
<b><i>Peãozinho</i></b> <sup>1</sup> <i>Micrandropsis sclerorylum</i> W. Rodr	0.99	Moderately easy to saw, screw and nail, receives an excellent finish.	Woodwork and carpentry

<sup>1</sup>INPA/CPPF (1989), <sup>2</sup>Barros (2016)

The structural parts of the table (base, wings and body) were made by three different processes using basic

carpentry machines and tools, as described in table 2. Figure 8 shows general views of the Arara (Macaw) coffee table with its structural parts.

Table 2 - Structural parts of the table, dimensions of waste wood and machines used in the process

Structural parts	Variation in the thickness of the residues (mm)	Machines used
Leaf-shaped base	<b>Part 1</b> - 10 to 15 <b>Part 2</b> - 20 to 30	Thickness planer, band saw, jointer, calibrator and circular sander
Wings	20 to 30	Thickness planer, band saw, jointer, calibrator, circular sander
Body	20 to 30	circular sander, thickness planer, calibrator
Top	the shape of the glass is oval (ellipse) with a thickness of 5mm.	

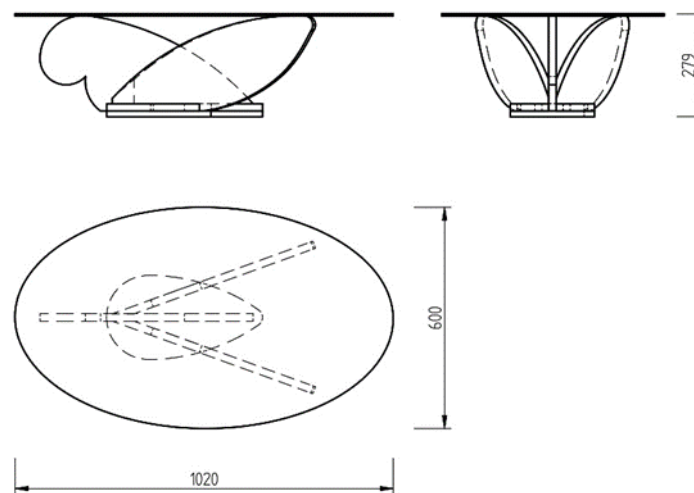


Figure 8. General views of the Arara coffee table.

During the manufacturing process, an excellent result was observed in the milling of the wood of all three species, an important factor as an indicator of product quality. Similar results were obtained by Froes *et al.* (2018) in their research with *matamata* wood. Thus, the finished product meets all the necessary requirements for insertion in the market, mainly because it is a sustainable product with a regional identity (Figure 9).



Figure 9. Arara (Macaw) table.

The opportunity was found to design a product that could be manufactured using waste from milling of certified timber and forest waste. This product is embedded in the context of Amazonian culture and is easy to manufacture for inclusion in the lumber industry's production line. The product is easy to construct and the process can be taught to third parties, since the technical details are presented so as to facilitate its large-scale production.

#### **4. Conclusion**

This study offers an alternative wood product with high added value, made from timber milling waste. Wood technology and design enables industries in the State of Amazonas to direct their waste to production of products with regional identity and the capacity to compete in foreign markets. It was developed from the analysis of elements of northern Brazilian regional identity and the classification of waste from the milling of certified wood and forestry residues. It has been observed that much of the wood is discarded or is burned to generate energy. In addition to the amount of wood wasted, two other factors were also analyzed: the first is the possibility of generating value through the culture of the northern region, specifically that of the state of Amazonas, through the manufacturing of products. The second is to leverage the production of the wood industry by making use of timber species from the region that do not have commercial value due to their dimensions and the lack of proposals that contemplate the use of these materials.

#### **5. Acknowledgements**

We are grateful to the Fundação de Amparo à Pesquisa do Estado do Amazonas - FAPEAM and the team from the Laboratório de Engenharia e Artefatos de Madeira - LEAM / INPA.

## 6. References

- Barbosa, A. N. F. (2009). *Projeto e desenvolvimento de produtos*. São Paulo: Atlas.
- Barros, S. V. S. (2016). *Avaliação da qualidade da madeira de árvores da Amazônia por método não destrutivo de propagação de onda: tomógrafo de impulso e stress wave timer*. Tese de Doutorado, 134 p. Instituto de Pesquisas da Amazônia, Manaus, AM.
- Bauer, J. M. Sellito, M. A. (2019). *Estímulos e barreiras para o aproveitamento de Resíduos de madeira na fabricação de briquetes: estudo de casos, Revista em Agronegócio e Meio Ambiente*. Maringá, out./dez. 2019, v. 12, n.4, pp. 1267-1289.
- Baxter, M. (2011). *Projeto de produto: guia prático para o design de novos produtos*. São Paulo: Blucher.
- Bonsiepe, G. (2011). *Design, Cultura e Sociedade*. São Paulo: Blucher.
- Cavalcanti, M. A. Nascimento, C. C. Azevedo, C. P. (2003). *Desenvolvimento de Modelos para Diagnosticar Rendimento e Desperdício de Madeiras em Três Serrarias da Cidade de Manaus*. 2003. XII Jornada de Iniciação Científica. PIBIC/INPA. INPA – Instituto Nacional de Pesquisas da Amazônia. Manaus/AM/Brasil, Manaus, 09 a 11 de julho de 2003, pp.201-202.
- CONAMA. (2016). *Conama inibe mercado de madeira ilegal: em sua primeira reunião plenária do ano, órgão aprova medidas para harmonizar regras de controle florestal e evitar comércio de madeira com origem em desmatamento ilegal*. 2016. Ministério do Meio Ambiente. Disponível em: <https://www.mma.gov.br/informma/item/13291-noticia-acom-2016-03-1491.html>. Acesso em: 26 set. 2020.
- Lima, D. C. Melo, R. R. Santana, R. R. C. Botan, E. Stangerlin, D. M. Santana, R. M. C. (2018). *Compósitos madeira-plástico manufaturados com resíduos de serraria e embalagens descartadas de polipropileno*. Nativa, Sinop, Mato Grosso, jan./fev. 2018.v. 6, n. 1, pp. 79-84.
- Marcon, J. L. et al (Org.) (2012). *Biodiversidade Amazônica: caracterização, ecologia e conservação*. Manaus: Edua, 2012. 372 p.
- Mendonza, Z. M. S. H. Borges, P. H. M. Pierin, L. C. (2017). *Coeficiente de rendimento em madeira serrada de oito espécies nativas de Mato Grosso*. Nativa, Sinop, Mato Grosso, dez. 2017, v.5, esp., pp. 568-573.
- Silva, G. M. Nascimento, C. C. (2016). *Ecodesign e o uso de resíduos de processamento mecânico e florestal: uma alternativa de desenvolvimento sustentável para comunidades*. In: Anais do SICASA e ANPPAS Amazônia. Manaus (AM) UFAM/ANPPAS. Disponível em:

<<https://www.even3.com.br/anais/IVSICASA/33139-ECODESIGN-E-O-USO-DE-RESIDUOS-DE-PROCESSAMENTO-MECANICO-E-FLORESTAL--UMA-ALTERNATIVA-DE-DESENVOLVIMENTO-SUSTENTAVE>>. Acesso em: 25/09/2020 16:48

Silva, G. M. Nascimento, C. C. Maciel, J. M. (2019). *Concepção de produtos para a utilização de resíduos madeireiros de espécies arbóreas da Amazônia*. Anais do 13º Congresso Pesquisa e Desenvolvimento em Design (2018), Blucher, São Paulo, 2019, pp. 37-50.



# **Historical Evolution of the Conceptual Practice Sustainability Terminology**

**Fátima Terezinha Silva Santos**

Universidade do Extremo Sul Catarinense – UNESC, Brasil – Programa de Pós-Graduação em Ciências Ambientais – PPGCA, [fatadv@terra.com.br](mailto:fatadv@terra.com.br)

**Nilzo Ivo Ladwig**

Universidade do Extremo Sul Catarinense – UNESC, Brasil – Programa de Pós-Graduação em Ciências Ambientais – PPGCA, [ladwig@unesc.net](mailto:ladwig@unesc.net)  
orcid.org/0000-0003-3031-0192

**Juliano Bitencourt Campos**

Universidade do Extremo Sul Catarinense – UNESC, Brasil – Programa de Pós-Graduação em Ciências Ambientais – PPGCA, [jbi@unesc.net](mailto:jbi@unesc.net)  
orcid.org/0000-0002-0300-1303

**Vilson Menegon Bristot**

Universidade do Extremo Sul Catarinense - UNESC, Brasil – Núcleo de Estudos em Engenharia de Produção – NEEP, [vilson.bristot@unesc.net](mailto:vilson.bristot@unesc.net)  
orcid.org/0000-0003-1814-6262

**Jori Ramos Pereira**

Universidade do Extremo Sul Catarinense – UNESC, Brasil – Programa de Pós-Graduação em Ciências Ambientais – PPGCA, [jori@unesc.net](mailto:jori@unesc.net)

## **Abstract**

*The article aims to analyze, in a formal historical approach, the conceptual evolution of sustainability terminology, which initially has an essentially ecological interaction, but begins to incorporate social values in its definition when establishing relation with the welfare of future generations. As a result, international society coined the term "sustainable development," which presupposes a preventive action, with practices of governmental regulations associated with initiatives that involve economic growth, social equity and global environmental conservation.*

**Keywords:** Society; economy; environment; sustainable development.



## **1. Introduction**

The study of the environment is necessary in view of the impacting reality to which humanity is exposed. World economic and technological expansion has subjugated ecosystems throughout history. Since the Middle Ages, nature has been seen as a mere resource for the economy. As a result, the process of environmental degradation is triggered in such a way that it ends up depleting natural resources. Nature ceases to exist giving way to a transformed environment, modified by modern society.

Starting from this perspective of transformations throughout history, we begin to analyze the origins of the term and the concept of sustainability, establishing the counterpoint to the concept of sustainable development in the different policies recommended in several international documents.

## **2. Origins of the Sustainability Concept**

The concept of sustainability is broad and has evolved throughout history, because, according to Bell and Morse (2008, p. 12), “people differ in the environmental, social and economic conditions in which they have to live, and have a the only definition that one tries to apply in all this diversity can be both impractical and dangerous ”.

Every construction of a concept for sustainability is the result of the industrialization process that Western Europe went through in the period of the Low Middle Ages between the 11th and 15th centuries, considered a pre-capitalist phase, and the period of the Modern Age between the 15th to the 18th centuries, with the expansion of the consumer market and the emergence of manufacturing (ARRUDA, 1999). For Marquardt (2006, p. 175, our translation), “the basic environmental problems of pre-industrial societies were not based on air or water pollution, but on the excessive use of forests and pastures”. It can be seen that in the period between the 12th to the 18th centuries there was great deforestation in central Europe, all due to the growing expansion of Eurasian colonization attracted by the nobles to the formation of agricultural societies. In other words, with the increase in population, there was a need to obtain wood for building houses, firewood for heating and obtaining coal for the industries that were beginning to move Europe (MARQUARDT, 2006).

The concern with the scarcity of wood in the seventeenth century was portrayed by Hanns Carl von Carlowitz, in 1713, in the work entitled *Sylvicultura oecômica*, in which the author foresees the need to preserve the key resource of the time. The issue addressed in the book is the cultivation of wood and its conservation, because, according to him, "there will be no continuous, stable and sustained use". Carlowitz uses and creates the term “nachhalternd” or “nachhaltig”, which literally refers to sustained income. Carlowitz foresaw a serious economic crisis with the extinction of forests, which in the long run would ruin Saxony's silver mines and metallurgical industry. His work suggests practices (saving wood) to solve the natural resource crisis, such as improving the thermal insulation of buildings and reducing the use of wood for energy in homes and industries (GROBER, 2007).

The concept of *nachhaltig* became part of a new scientific approach to forestry. In Germany, forests had their soils evaluated, animals and plants classified and wood reserves calculated, aiming at sustainable production. For Carlowitz, there would be a need to take care of forest renewal, that is, use natural resources sparingly and in the long run, recognizing that there are limits to the use of these resources (GROBER,

2007).

It is seen that the main characteristic of this historical period is the agricultural dependence, the use of the land above its ecological load capacity and the pressure to create a sustainable system for the use of the environment (MARQUARDT, 2006).

From 1730, some factors contributed to the increase in the European population. After the period that was the black plague epidemic, which decimated a large part of the population, industrial production, mainly of textile products, grew and was concentrated in large urban areas. Policies in some kingdoms stimulated the birth rate, as this would mean a greater military contingent and greater tax collection. All this contingency came against the objective that was the optimization of the population in relation to its ecosystemic capacity (MARQUARDT, 2006).

The changes that took place between 1789 and 1848 triggered the removal of the agrarian system. First, the Enlightenment preached liberal, physiocratic and state economic theories, with a new mechanistic view of nature.

Legislative state intervention removed the protection of the environment by individualizing property, resulting in the disappearance of the traditional right to sustainability. The new model allowed the individual to have absolute power over nature without public protection (MARQUARDT, 2006).

The Industrial Revolution was also significant in the environmental context, replacing a renewable energy system, based on wood, with a non-renewable one, based on fossil energy from coal, and later on, oil. This whole phenomenon was called economic growth (MARQUARDT, 2006). For Cameron (2004, p.26), "economic growth is a sustained increase in the total production of goods and services produced by a given society".

At the end of the 19th century and the beginning of the last century, more precisely in 1900, several European countries still used coal as an energy source. Fossil fuels and electricity created the modern world, increasing agricultural productivity and mechanizing industrial production, taking the agricultural workforce to megacities, mainly in the service sector, globalizing trade and culture (SMIL, 2004).

It should be noted that economic growth and wealth creation increased by 1730 times between 1800 and 1970, together with the triple increase in the world population from 978 million to 3,632 million inhabitants (DU PISANI, 2007).

However, this twentieth-century energy transition raised the population's standard of living, but disparities between rich and poor societies remained. And, even more, the use of energy causes an imbalance in urban life, such as pollution and environmental degradation from thermonuclear plants, for example (SMIL, 2004).

For Smil (p. 561), "the only guaranteed result of greater use of energy is the increase in environmental burdens whose global impacts can put the biosphere's habitability at risk" (our translation). It must be understood that "we are a part of nature, not part of nature" (RICKLEFS, p. 521).

The crucial question, since the beginning of the last century, is to determine what types of policies should be applied efficiently and effectively in building a sustainable global economy. As Costanza et al. (2013, p. 78), we need to reconstruct the concept of what the economy is, and what it is for. According to the author and co-authors, the objective of the economy must be to sustainably improve human well-being and quality of life and that material consumption and GDP are mere means to that end.

Likewise, Gardner (2013, p. 53) considers that "industrial nations continue to build economies based on disposable". We are consolidating a sterile economy in material terms. If there is no serious world policy, consolidated in projects for the rational use of non-renewable resources, as well as in the effective recycling of these resources, the trend will be the use of new technologies in the creation of new materials that will replace those that have been exhausted.

Morin (2010, p. 54) highlights that "we are on a planet that lives, falters, without certain provisions for tomorrow". The author establishes a dialectical conception of the world, in which he states that the first difficulty in thinking about the future is the difficulty in thinking about the present. This "blindness" puts us in a connection between the past and the present and from the present to the future, because everything that is evolutionary "is drift, transgression, creation; it is made of ruptures, crises" (Ibidem, p.15). It is in this tuning fork that economic growth presents itself with the idea of qualitative progress. However, "all progress is partial, local, provisional, the product of degradation, of disorganization" (Ibidem, p. 29).

### **3. Sustainability and Development**

As we mentioned earlier, global societies are growing alarmingly and are "not only interconnected through political, economic and technical systems, but also through biophysical systems to support life on Earth" (FOLKE, 2013, p. 20).

Humanity has not yet awakened to the sense of responsibility it has over planet Earth. Folke externalizes this concern by referring that the development of society will start from the moment that people "contemplate and manage natural capital and systemic services, not only to save the environment, but for the sake of our own development" (Ibidem, p. 27).

Holistic reflections made by Capra (2005, p. 268) exalt that "the objective of the global economy is to raise the wealth and power of the elites to the maximum, while the objective of the ecological project is to raise the sustainability of the web to the maximum of life".

According to Capra, in the 21st century we must change our values in terms of the global economy, with responsibility, human dignity and ecological sustainability (Ibidem, p. 268).

We see, therefore, that the term sustainability appears to be linked to a global economy that must be focused on the well-being of environmental and social systems.

In the strictest sense, global sustainability means the indefinite survival of human species in all regions of the world. In a broad sense, human beings who are born and reach adulthood must have quality of life beyond mere biological survival (BROWN, 1987).

The sustainability of the development process implies the reorganization of urban settlements and the establishment of new functional relations between the countryside and the city. The challenge is to generate strategies that make it possible to articulate and integrate populations in a diverse and sustainable world (LEFF, 2001, p. 61).

The term sustainability is related to unchanged environments, but, to the extent that no natural system can be immutable, it is desirable to limit the impacts of human action on the environment (MCKENZIE, 2005).

In this same understanding, Boff (1999, p. 111) considers sustainable that economic growth and social

development that were made according to the community of life, that produced according to the capacity of the biome, that met the demands of our generation with equity, without sacrifice natural capital, and be open to the demands of future generations.

Sustainability should not be analyzed in isolation. It is transdisciplinary, existing where there is cooperation, synergy and permanent dialogue between global society and natural ecosystems. At the beginning of environmental studies, sustainability had its concept linked to man / nature issues. However, as Elkington (2001, p. 1) asserts, the world managed by sustainable capitalism guided sustainability under the focus of harmonization between traditional financial pillar and emerging environmental thinking. But now the focus is on "economic prosperity, environmental quality and social justice".

This dynamic, the interconnection of the so-called development and sustainability, had its inaugural mark with the anxiety of Rachel Carson on the occasion of the launch of her book *Silent Spring* in 1962. It is in this work that Carson refers us to the impacts of technology and, mainly, of industries on human life and the environment. The chemical industry in the United States was booming, and the indiscriminate use of pesticides in crops was contaminating humans and biota.

Carson (2010, p. 22) makes an analysis and argues that "the human being acquired significant power to change the nature of his world" and that "this power not only increased until it reached a worrying magnitude but also changed its character". She situates this issue as moral, as she questions "whether any civilization can wage an incessant war against life without destroying itself without losing the right to be called civilized" (Ibidem, p. 95).

From the considerations made by Carson in his work, the world became aware of the consequences arising from technological and scientific progress. It was seen that the development of society as a whole is a process that requires interactions, it cannot be achieved by individual initiatives.

After Carson, environmentalists and scientists like Barry Commoner emerged, concerned with environmental issues. Commoner, in his work *The Closing Circle* (1971, p. 1), reports that, with Earth Week, instituted in April 1970, in the United States, there was an awakening to the environmental danger that advanced over the American and world population. The author seeks to understand why, starting in 1956, environmental pollution increased dramatically and mentions that the "urgency of public understanding of the origins of the environmental crisis and its possible solution" (Ibidem, p. 4) should be accessible to the general public so that citizens could participate and know the risks to which they would be exposed.

Other concerns were noted in 1972 by the authors of the document entitled *Limits to Growth* (MEADOWS et al., 1978, p. 11), a report produced by the Club of Rome, an informal and international organization.

The report draws attention "to the exponential nature of human growth, within a closed system" (Ibidem, p. 185), requiring that "society be returned to objectives of balance and not growth" (Ibidem, p. 188), requiring "an effort of understanding, imagination and political and moral determination" (Ibidem, p. 189).

Amid all the alerts made by the Report, in the same year of 1972, the United Nations Conference on the Human Environment (UN, 1972), better known as the "Stockholm Declaration", was held in Stockholm, Sweden. In it, there was recognition by the legal system of the environment as a fundamental right of man,

in which it was established in the first principle that “man has the right to freedom, equality and to enjoy adequate life in a quality environment for lead a dignified life with well-being and the solemn obligation to protect it for present and future generations”. This essential character of the environment for the dignity of human life and its preservation is revealed as an affirmation, as a fundamental right of all humanity.

The Stockholm Conference served to indicate to the UN General Assembly the creation of the United Nations Environment Program (UNEP), which started operating in 1973 with the aim of coordinating the World Environment Fund, implementing international actions to regulate human activities and prevent the degradation of the planet.

Adams (2006, p. 1, our translation) points out that in the creation of UNEP, the concept of sustainability "was created explicitly to suggest that it was possible to achieve growth and industrialization without environmental damage".

In 1992, twenty years after the Stockholm meeting, the UN organized in Rio de Janeiro the Second Conference on the Environment, ECO-92 or Rio-92. More than 170 countries participated in this Conference, where they concluded that development must be adequate to the pace of environmental processes and that preserving a healthy environment is an indispensable condition to guarantee a peaceful future for new generations.

For Sachs (2000, p. 49), “the imperative ethics of synchronic solidarity with the current generation was added to the diachronic solidarity with future generations [...] the social contract on which the governability of our society is based must be complemented by a natural contract”.

As Oscar Motomura (2009) rightly states, no deliberation on sustainability should take place without taking into account the systemic in time and space, that is, the question of the legacies received and those we will leave for future generations. For the author, integrating with time means giving respect to the natural assets that are a legacy received in the construction of a sustainable future.

With the advent of modernity, the unlimited expansion of the productive forces generated ecosystem imbalances and attacked the environment as a whole. These are systemic problems that are interconnected and interdependent. The systemic view of life presupposes a way of thinking with an emphasis on the whole, that is, living systems are organized in a connected and interrelated way. In the case of the environment, systemic thinking encompasses man and nature with all its elements. Any damage to the environment is reflected in the community due to its character of interaction and interdependence (CAPRA, 1999).

For D’Ambrosio (1999, p. 647), “the challenge posed by the search for understanding the world in its entirety presupposes that the dimensions of survival and transcendence are assumed in their complementary relationship”. The author describes the phenomenon of life as a result of integrality, of the harmony of the individual connected mutually between the reality that surrounds him, in an eternal search for survival, and the interaction with society in respect for the other in the search for the preservation of natural and cultural.

Ribeiro (2009) reinforces the idea of D’Ambrosio by constituting the term ecologize in the context of the harmonization of natural processes. For the author, society, organizations and individuals have been ecologizing “by collective and participatory action methods, strategies and long-term planning” (p. 28) in an “internalization of ecologically responsible values and behaviors” (p. 35).

In this same understanding, Weiss (1992), when creating the Intergenerational Equity Theory, relates human generations to the natural system without distinction within a temporal dimension. In an



anthropocentric view, a generation that degrades the environment has a responsibility and a duty to restore the system for future generations.

The organizational capacity in the face of perceived threats arising from modernity is spreading across the social network, and the problems of the accompanying risks are a crucial point of responsibility for all.

To understand the living conditions of contemporary society is to be led to reflect on the development of modernity. Modernity, understood here, according to Giddens (1991, p.11) as "style, custom of life or social organization that emerged in Europe from the 17th century and that later became more or less worldwide in its influence". And the influence is linked to social evolutionism, to the changing world that the era of modernity presents to us.

The period of modernity that we are experiencing is characterized as a Reflective Modernity, in which "social practices are constantly examined and reformed in the light of renewed information about these own practices, thus constitutively altering their character" (Ibidem, p. 45).

There is, therefore, a need to understand environmental problems, conflicts generated in the face of uncertainties regarding viable alternatives to sustainable development. The development of modern society, according to Giddens, is based on personal self-flexibility, in which one must reflect on oneself, on the practices that are in the structure, seeing oneself to recognize a society at risk.

The uncertainty and lack of security in what is to come are characteristic and evident features of contemporary society. The lack of defining parameters of control over industrial modernization leads us to believe and admit that we are in an abstraction system, in which information is complex, but it is believed and trusted that the understanding of the transformations is being realized, even that "actors", according to Giddens, are unaware of the technological involvement and responsibilities that they imply.

It turns out that the term sustainability due to its "weaknesses, inaccuracies and ambivalences", as described by Veiga (2006), had its notion added in world politics due to the concept of sustainable development instituted by the Brundtland Report.

The Report *Our Common Future*, prepared by the UN World Commission on Environment and Development in 1987 (CMMAD, 1991), under the direction of Norway's first Minister, Gro Brundtland, defines sustainable development as "one that meets the needs of the present without compromise the possibility for future generations to meet their own needs" (p. 46).

The Brundtland Report, as it became known, criticizes the development model to which we are subjected, shaped by economic growth at the expense of social differences and without harmonization with the ecosystem. Likewise, it points to the incompatibility between sustainable development and the current production and consumption patterns.

In the analysis of the report, it is seen that measures are proposed linking the population, food security, ecosystems, energy, industry and urban issues in promoting sustainable development. Likewise, it recommends research in the field of renewable energy as a central point for long-term investments, as it considers an untapped potential.

We recall that, during Rio-92, a document called Agenda 21 was signed that proposed numerous actions for environmental recovery of the land to be operationalized until the 21st century, which did not actually occur, but served to map the environmental conditions of the entire planet.

Agenda 21 aimed to promote, on a worldwide scale, a new standard of development combining

environmental protection, social justice and economic efficiency.

The Agenda 21 document (1995), organized in 40 chapters, served as a guide, a roadmap to be followed by industries, companies and governments in driving economic growth combined with sustainable development. Among the principles to be followed for its implementation, are:

- a) cooperation and partnership between countries at government, national, local levels and among various segments of society;
- b) promoting education as an instrument for analyzing and raising awareness of community participation in solving global environmental problems;
- c) strengthening of the main socially vulnerable groups;
- d) integrated planning with national and international cooperation instruments and mechanisms to achieve development;
- e) information for decision-making by improving the availability of social, economic, ecological, environmental and development-related data.

Ten years after Rio-92, the countries were again summoned to address the environmental issue. The World Summit on Sustainable Development - RIO + 10, which took place in 2002 in Johannesburg, South Africa, was an attempt by the UN to reassess and implement the conclusions and guidelines obtained at Rio-92. With the presence of 189 countries, Rio + 10 ended with little progress in relation to public policies.

Reaffirming the commitments at the previous Conferences, in 2012 the so-called Rio + 20, United Nations Conference on Sustainable Development, took place in Rio de Janeiro, which produced a 53-page document entitled “The Future We Want”, which highlights the effort for the combating poverty and hunger, protecting the oceans and biodiversity, as well as encouraging agriculture and renewable energy.

As a result of Rio + 20 and the need to face new development challenges, in 2015, the 193 Member States of the United Nations established an action plan to end in 15 years the extreme poverty, inequalities and injustices on our planet. To this end, the States built the 2030 Agenda for Sustainable Development composed of 17 objectives and 169 goals to be implemented in an integrated and indivisible way in a balance of the economic, social and environmental dimensions of development. Here are the objectives outlined:

- a) Objective 1. End poverty in all its forms, in all places;
- b) Objective 2. End hunger, achieve food security and improve nutrition and promote sustainable agriculture;
- c) Objective 3. Ensure a healthy life and promote well-being for all, at all ages;
- d) Objective 4. To ensure inclusive and equitable and quality education and promote opportunities for lifelong learning for all;
- e) Objective 5. Achieve gender equality and empower all women and girls;
- f) Objective 6. To ensure the availability and sustainable management of water and sanitation for all;
- g) Objective 7. To ensure reliable, sustainable, modern and affordable access to energy for all;
- h) Objective 8. To promote sustainable, inclusive and sustainable economic growth, full and productive employment and decent work for all (AGENDA 2030, 2015).

Many criticisms were received in the formulation of global policies for the achievement of objectives and targets. According to Langford (2016, p. 173), there are a large number of commitments, with a more



“decorative” than “operational” agenda. Likewise, there is no mention of the participation of civil society in achieving the objectives, nor political, legal or administrative responsibility for non-compliance by States.

Jeffrey Sachs (2016) recognizes that objectives and goals are necessary, but require local activism and real politics, such as pressuring governments to produce their plans to achieve sustainable development, involving universities, companies and civil society in proposing actions to achieve the objectives and inspection in its implementation.

We live in a time of the “Age of Sustainable Development”, when the challenge is to strengthen all institutions in an integrated way in the planning of multisectoral actions with a view to reaching and guaranteeing the social, economic and environmental dimensions in the development of Nations.

#### **4. Conclusion**

There is a complexity in assigning a concept to the term sustainability. Its historical trajectory is related to the environmental discourse "man / nature", in the sense of interdependence of ecosystems. From the 1970s onwards, sustainability began to be seen as an impediment to development and the environmental issue started to be incorporated into world policies. In the 1972 Limits to Growth document, the warning is given when seeing a society being swallowed up by unbridled economic growth. In the Stockholm Declaration of the same year, economic development linked to environmental conservation is advocated, and cannot be achieved by isolated initiatives. There is a need for interdependence between society and the environment.

All international documents after the initial Stockholm landmark advocate sustainable development in line with the three pillars created by Elkington (Ibidem, p. 75-77): economic, social and environmental (Triple Bottom Line), in which society depends on the economy and the economy of the ecosystem, which, in turn, represents global health, that is, the ultimate pillar, the environmental. The author maintains that these pillars are not stable, they are subject to social, political, economic, environmental pressures and to cycles and conflicts.

However, we must reflect on the following questions: What should be sustained? Who is sustainability for? What is the time period to arrive at the expected results?

We must keep in mind that sustainability is a process that, in order to be operationalized, requires the integration of preserved environmental assets with sustainable economic development.

#### **9. References**

- [1] ADAMS, W. M. The Future of Sustainability: Re-thinking Environment and Development in the Twenty-first Century. Gland, Switzerland: World Conservation Union, p. 1-18. 2006. Disponível em: <<https://portals.iucn.org/library/sites/library/files/documents/Rep-2006-002.pdf>>. Acesso em: 4 fev. 2018.
- [2] AGENDA 21 – Brasília: Câmara dos Deputados, Coordenação de Publicações, 1995. Disponível em: <<http://www.onu.org.br/rio20/img/2012/01/agenda21.pdf>>. Acesso em: 24 fev. 2018.

- [3] AGENDA 2030. Objetivos do Desenvolvimento Sustentável (ODS). Disponível em: <<https://nacoesunidas.org/pos2015/agenda2030/>>. Acesso em: 22 fev. 2018.
- [4] ARRUDA, José Jobson. História Total 4. Idade Moderna e Contemporânea. 2. ed. São Paulo: Ática, 1999.
- [5] BELL, Simon; MORSE, Stephen. Sustainability Indicators: Measuring the Immeasurable? 2nd. Ed. Londres: Earthscan Publications Limited, 2008.
- [6] BOFF, Leonardo. Saber Cuidar Ética do humano – compaixão pela terra. Petrópolis, RJ: Editora Vozes, 1999.
- [7] BROWN, J. B.; HANSON, M. E.; LIVERMAN, D. M.; MEREDITH, R. W. Global Sustainability: Towards Definition. *Environmental Management* 11 (6), 1987. 713-719. <<https://doi.org/10.1007/BF01867238>>. Acesso em: 22 de fe.2018.
- [8] CAMERON, Rondo. História Económica do Mundo. Publicações Europa-América, 2. ed. Mem-Martins, 2004.
- [9] CAPRA, Fritjof. As conexões ocultas: ciência para uma vida sustentável. Tradução de Marcelo Brandão Cipolla. São Paulo: Cultrix, 2005.
- [10] CAPRA, Fritjof. A teia da vida. 4. ed. São Paulo: Cultrix, 1999.
- [11] CARSON, Rachel. Primavera silenciosa. Tradução de Claudia Sant'Anna Martins. São Paulo: Gaia, 2010.
- [12] CMMAD. Comissão Mundial sobre Meio Ambiente e Desenvolvimento. Nosso futuro comum. Rio de Janeiro: Editora Fundação Getúlio Vargas, 1991.
- [13] COMMONER, Barry. The closing circle: Nature, Man, and Technology. New York: Knopf, 1971.
- [14] COSTANZA, Robert et al. Construindo uma Economia-na-Sociedade-na-Natureza Sustentável e Desejável. In: ASSADOURIAN, Erik; PRUGH, Tom (Orgs.). Universidade Livre da Mata Atlântica. Estado do mundo 2013: A Sustentabilidade Ainda é Possível?/Worldwatch Institute. Salvador, BA: Uma Ed., 2013. p.78-94.
- [15] D'AMBROSIO, Ubiratan. Ética ecológica. Uma proposta transdisciplinar. In: VIEIRA, Paulo Freire; RIBEIRO, Maurício Andrés (Orgs.). Ecologia humana, ética e educação: a mensagem de Pierre Danscreau. Porto Alegre: Palotti; Florianópolis: APED, 1999, p. 639-654.

- [16] DU PISANI, Jacobus A. Sustainable development – historical roots of the concept. *Environmental Sciences*, 3:2, 83-96, DOI: 10.1080/15693430600688831. Downloaded by [168.196.182.175] at 13:35 09 January, 2018.
- [17] ELKINGTON, John. *Canibais com garfo e faca*. Tradução de Patrícia Martins Ramalho. São Paulo: Makron Books, 2001.
- [18] FOLKE, Carl. Respeitando os Limites Planetários e nos Reconectando à Biosfera. In: ASSADOURIAN, Erik; PRUGH, Tom (Orgs.). *Universidade Livre da Mata Atlântica. Estado do mundo 2013: A Sustentabilidade Ainda é Possível?* /Worldwatch Institute. Salvador,BA: Uma Ed., 2013. p.19-27.
- [19] GARDNER, Gary. Conservando recursos não-renováveis. In: ASSADOURIAN, Erik; PRUGH, Tom (Orgs.). *Universidade Livre da Mata Atlântica. Estado do mundo 2013: A Sustentabilidade Ainda é Possível?* /Worldwatch Institute. Salvador,BA: Uma Ed., 2013. p. 51-64
- [20] GIDDENS, Antony. *As consequências da modernidade*. São Paulo: UNESCP. 1991.
- [21] GROBER, Ulrich. Wissenschaftszentrum Berlin für Sozialforschung gGmbH (Ed.): *Deep roots - a conceptual history of 'sustainable development' (Nachhaltigkeit)*. Berlin, 2007 [23] (Discussion Papers / Wissenschaftszentrum Berlin für Sozialforschung 2007-002). Disponível em: <<http://nbn-resolving.de/urn:nbn:de:0168-ssoar-110771>>. Acesso em:22 fev. 2018.
- [22] LANGFORD, M. Lost in Transformation? The Politics of the Sustainable Development Goals. *Ethics & International Affairs*, 30(2), p. 167-176. 2016. Disponível em: <<https://www.cambridge.org/core/journals/ethics-and-international-affairs/article/lost-in-transformation-the-politics-of-the-sustainable-development-goals/B564424E327013BE5CBA0F6715C23F7F>>. Acesso em: 23 fev. 2018.
- [23] EFF, Enrique. *Saber ambiental. Sustentabilidade, racionalidade, complexidade, poder*. Tradução de Lúcia Mathide Endlich Orth. 2. ed. Petrópolis, RJ: Vozes, 2001.
- [24] MARQUARDT, Bernd. Historia de la sostenibilidad. Un concepto medioambiental en la historia de Europa central (1000-2006). *hist.crit.*, Bogotá, n. 32, p. 172-197, dic. 2006. Disponível em: <[http://www.scielo.org.co/scielo.php?script=sci\\_arttext&pid=S012116172006000200008&lng=es&nrm=iso](http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S012116172006000200008&lng=es&nrm=iso)>. Acesso em: 26 dez. 2017.
- [25] MEADOWS, Dennis L; MEADOWS, Donella H; RANDERS, Jorgen. *Limites do crescimento. Um relatório para o Projeto do Clube de Roma sobre o dilema da humanidade*. Tradução de Inês M. F. Litto. 2. ed. São Paulo: Perspectiva, 1978. (Coleção Debates)

- [26] MORIN, Edgar. Para onde vai o mundo? Tradução de Francisco Morás. Petrópolis, RJ: Vozes, 2010.
- [27] MOTOMURA, Oscar. Desenvolvimento sustentável. Princípios éticos para um efetivo fazer acontecer. Disponível em: <http://www.ecodesenvolvimento.org/colunas/oscar-motomura/desenvolvimento-sustentavel-principios-eticos-para#ixzz3pR9TXO6F> Acesso em: 5 fev. 2018.
- [28] MCKENZIE, Stephen. Social sustainability, religious belief and global ethics: outlines for research. Hawke Research Institute Working Paper Series, n. 0, University of South Australia, 2005.
- [29] ORGANIZAÇÃO DAS NAÇÕES UNIDAS. Conferência das Nações Unidas sobre Meio Ambiente. Disponível em: <<http://www.un-documents.net/aconf48-14r1.pdf>>. Acesso em: 4 fev. 2018.
- [30] RIBEIRO, Maurício Andrés. Ecologizar: Princípios para a ação. Brasília: Universa, 2009. v. I.
- [31] RICKLEFS, Robert E. Economia da Natureza. 6. ed. Rio de Janeiro: Guanabara Koogan, 2010.
- [32] SACHS, Ignacy. Caminhos para o desenvolvimento sustentável. Rio de Janeiro: Gramond, 2000.
- [33] SACHS, Jeffrey. The Conversation. Disponível em: <<https://theconversation.com/jeffrey-sachs-on-meeting-the-sustainable-development-goals-we-need-a-victory-of-ideas-66839>>. Acesso em: 23 fev. 2018.
- [34] SMIL, Vaclav. World History and Energy. Reference Module in Earth Systems and Environmental Sciences, from Encyclopedia of Energy, 2004, p. 549-561.
- [36] VEIGA, José Eli da. Meio ambiente & desenvolvimento. São Paulo: Editora Senac, 2006.
- [36] WEISS, Edith Brown. In Fairness To Future Generations and Sustainable Development. American University International Law Review 8, n. 1, p. 19-26, 1992. Disponível em: <<http://digitalcommons.wcl.american.edu/auilr/vol8/iss1/2/>>. Acesso em: 8 fev. 2018.

# **Sustainable Transport System at the Federal University of Amazonas**

**Willian Antonio Malveira da Silva(MSc)**

Professor, production engineering

Manaus-AM, Brazil Email: willianssmaill@gmail.com

## **Abstract**

*The city mobility likewise the city dynamics might be influence the university space and how will be working the campus mobility. Some studies point out which herewith the cities' evolution, the universities have been developed the same mobility behavior as well as is influenced by the city model. Recently was investigate the constraints and how much it is possible to provide sustainable mobility at the campus. This issue will show the Federal University of Amazonas case. Nowadays, the university transport model is the same as the micro city kinds, at the regional system have been some constraints in the service level as in the sustainability performance. On the other hand, Amazon's university performance is smoothing the sustainable impact and minimize the ecological footprint by the green area at the campus; it is the very important front of the climate change actions to hit the temperature global goals. This article is shown which is possible to improve sustainable mobility at the campus when is provides other mobility kinds and redesign the transport systems.*

**Keywords:** Sustainable mobility, University mobility, Sustainable transport sustem

## **1. Introduction**

In recent years, mobility systems in universities have been studied around the world, this is due to the contingents that start to transit in the university space. Many authors studying transport and mobility systems in the university environment considered the models implemented as one of a city. Therefore, they identify them as micro cities because these models come close to urban geographic space. In many cases, the university environment has a population impact that is as big as a neighborhood. In this sense, there are universities contingent is bigger than the population of the city. For these reasons, among others, the university space has been demanding a certain amount of attention regarding the level of mobility services and transport services of the university community.

A common study to be observed, is the case that evaluates the behavior of the university public, regarding the type of service provided and its variations, in general it was observed that universities generate a large number of trips, which depending on the modes of transport and mobility generate negative externalities such as levels of greenhouse gas emissions. The Federal University of Amazonas-UFAM has a mobility profile very similar to that of large universities such as Yale, Kant University, where the demand for a level of mobility services that is predominantly met through private vehicles and buses. In the case of collectives, they are executed by concession contracts made with the City Hall. Thus, the mobility models of the university when generating the demands for travel, maintaining a usual format, generates a level of

pollution that can be improved by applying a more flexible model and using cleaner technologies.

Thus, through the essay “Sustainable Mobility of the University Space”, an analysis is made of the present model of mobility and shows other models applied in other university centers. The study points out alternatives that may contribute to generating positive externalities on the Manaus campus. These alternatives are directly related to the acceptance of the academic community to use other modes of transport in the mobility process. And here, it is shown that the city's predominant mobility model influences campus mobility. However, the study sought to understand why a more flexible model is not used in the campus environment. The relevance of the study may show that there is an interest in the use of other modes. This fact can make the campus environment a reference for other urban environments in the city. The study approach here will be presented in six sections, is outlined as follows: In the first part, this is a presentation of the theme and how it will be presented, the study's problematic and relevance. Part two will be an exposition of a presentation of sustainable models and a comparison between the models applied in other university centers, in part the study will show a literature review, where other studies on the topic will be shown, methodologies that have been adopted. The profile of the Federal University of Amazonas-UFAM and pointing out hypotheses of possible mobility models that are appropriate to the regional and specific characteristics of the university will be the third phase. The next section deals with the presentation of the adopted methodology and lastly, the discussion and conclusion of the theme followed by references.

## **2. Planning in the Brazilian cities.**

In Brazil, the transport system concession system is regulated by law 8987/95, where article 6 provides for efficiency, safety, and timeliness of the system. And when current issues are addressed here as well as efficiency, modernity is generally considered, which implies the issues of innovation and sustainability. As noted, urban environments have been looking for cleaner and more efficient mobility alternatives, which is a factor of modernity and efficiency. This process requires strategic planning and application of a range of knowledge in a multidisciplinary format, without considering the process of urban space growth, which is a challenge. Regarding the management of urban space in Brazil, law 10.257/2001 known as the city statute is the instrument that regulates Brazilian urban structures. Among the guidelines proposed by the law (Article 2), the issue of guaranteeing sustainability was observed among several factors that may include the development of smart and sustainable cities. Many cities started to adopt restrictive measures by zones of the city, applied a diversity of transport modes as well as the connectivity between the modes. Large urban centers have developed master plans for a horizon of more than ten years, aiming to reduce the use of individual vehicles, improving the modes of mass transportation, and implementing alternative models. At this point, many cities have adopted systems of shared mobility that can be applied to vehicles, bicycles, and scooters, these influence and are influenced by factors such as (COHEN, A., SHAHEEN, S.A.; Jul. 2016):

- Transport and circulation: This factor influences the choice of modes and distance to be traveled;
- Zoning and land use: This factor requires planning at the level of zoning, management, and demand for

parking spaces, etc.;

- Urban design: This point is related to the issues of connectivity between modes and encouragement to reduce the use of individual vehicles;
- Residences: Because of them, there is a reduction of car parks demanding new development;
- Economic development: It can generate new jobs and income opportunities.

As the mobility model of the UFAM/Manaus university is directly related to the urban mobility model of the city and its characteristics, it reflects all the things that happen in the system, if the model has an inefficient format and generates negative externalities it will also affect the university mobility. On the other hand, this study raises the idea of taking advantage of the university space as a mobility model for the city, in the case of adopting more sustainable mobility modes where the structure of the transport system can affect the form of land use (KEHINDE, 2019).

### ***1.1 Review and state of the art.***

In studies carried out at the University of Toronto-Canada, it was noticed that education and information campaigns did not effectively contribute to changes in people's behavior in the sense of adopting cycling practices. However, users' behaviors were shaped by the barriers they faced. At this point, the perceived restrictions were as follows:

- (1) Physics;6
- (2) Social;
- (3) Financial and;
- (4) Psychological.

According to studies, bicycle sharing in Brazilian cities is motivated by health and environmental issues, according to Cerutti et al (2019) apud Mont et al (2020, pg7), the study also considers the perception of non-users, primarily women, who report the fact that they realize that the infrastructure of cities is not sufficiently secure. One way to shape a change in behavior to implement new practices would be through standardization. Command and control rules can influence the behavior of families and people involved (RIVAS, 2014). Concerning incentives, in the study by SAVAN et al. (2017), the case of Canada, it was observed that the combination of incentives and information had more results than financial incentives. Here, care must be taken as to the type of information and how to guide the academic community regarding the correct use of public goods. This is a situation that is effectively raised by environmental responsibility. This is related to the observation of the target audience and management of the process, according to Slack et al (2018), in the same way, that emissions or residues are reduced, avoiding costs for the organization, and this must be taken into account consideration in the development of the project.

An example can be seen in the case of the government of Denmark which developed in 2012 a strategy to implement innovative actions through public-private partnerships that encourage environmental initiatives, for this it designed an action agenda for 2020, this strategy was based on five pillars:

- Prepare for climate change;
- Environmentally friendly transport system;



- Reorganization of energy systems
- Produce energy efficiently
- Green shopping (environmentally friendly)

As for the mobility system, Denmark made a major investment in the implementation of cycle paths, not only that, developed regulations, and worked on issues of education and safety, leading Copenhagen to be a reference in the use of bicycles and pedestrian structures. Today, around 50% of citizens use bicycles as a means of transport. The municipal governments made investments in specific spaces for the circulation of this modal, spaces for bicycle parking spaces were created (OECD, 2012).

The implementation of an eco-efficient process reduces costs with energy consumption and generates a lower level of emissions. Thus, following the target audience of the action, we must observe which restrictions can be removed and establish a commitment strategy, as well as increase the integration between modes. According to Azzali and Sabour (2018), when planning a campus considering parking space, air quality, and limited financial resources, the most applied common strategy is the use of bicycles and walks. One factor in the study by Azzali and Sabour is "How much university mobility can impact on local society?", that is, what externality is being generated in their mobility process. Thus, according to the model adopted, a social impact usually results in congestion or accessibility problems. Indirectly, by reducing congestion, or the less it occurs, the greater the energy use. On the other hand, according to Allen & Farber (2018), they understood how the student travels, from home to campus, from work to campus, which can negatively affect their academic activities. This understanding attests that social activities can enrich learning by enhancing opportunities to enter the job market a low level of accessibility can limit the opportunity for people's availability, reaching a type of social exclusion. The accessibility is one of the transportation study lines that are related to how the city can implement interactions including benefits, work, and services. The same involves factors such as:

1. Use of soil;
2. Partnerships;
3. Form of travel;
4. Time of day
5. Socio-economic standard

The Castro et al Study (2019) showed the importance of the implementation of Flores Avenue and shows how relevant the impact in the region caused by deforestation is also. At this point, if considered zoning, it can be observed that the investment in infrastructure for the implementation of cycle paths and terminals appropriate for this modal would have a low environmental impact.

### **3. Mobility Planning in the Brazilian cities.**

The Federal University of Amazonas is considered the first in a green fragment at the urban area in the country with 6.7 million square meters. In general, the University has something around 65% of the green

area. This factor is a differential if we consider the generation of ecological footprint and the levels of emissions generated that can have a softening impact since this area is of mature forest, which is not growing. About the others studied, this is a differential. As for the adopted model of mobility on campus, currently, a system powered by two bus lines and an integration line (circular) that makes a connection between campuses (north and south sector) is used, the interconnection between campuses is the order of up to 3 (three) kilometers. According to the Dean of Teaching and Graduation/PROEG (2019), UFAM offers something around 114 on-site courses in various modalities comprising more than 20 (twenty thousand) students. Thus, unlike other mobility studies for university campuses, this study was aimed at formulating proposals that will implement alternative modes of mobility on campus, thus concluding the phase of applied research. From the elaboration of the questionnaire, it was obtained a proportion of the participants on the use of modals for commuting between campuses and to the campus. The data obtained can be seen in the graph of (figure 01). Here, we analyzed only the lines that originate from the campus.

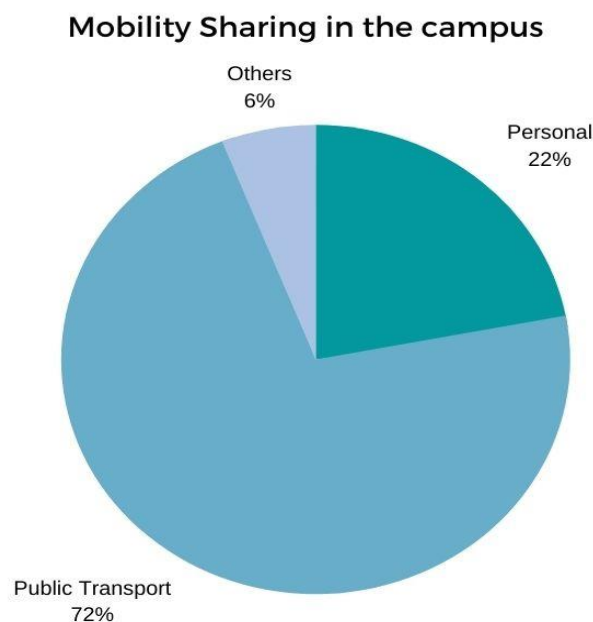


Figure 1: Modal transports in the campus

Source: the author

As expected, more than 77% of the academic group is a public transport user, so the current mobility configuration on the university campus is very close to the studies done by David Kaplan (2015). They studied the level of sustainability of mobility at Kent State University, as well as a model very close to what is called micro cities. In the case of the UFAM university campus in Manaus, the use of cleaner modes such as bicycles, in the data collection showed that less than one percent of those who participated in the survey use bicycles (0.4%).

In general, studies have shown that the university community has an interest in using bicycles in the campus environment, lacking motivators, and specific infrastructure for this. As for the service provided by regional

collectives, improvements may be implemented, given the present model adopted in the city, it needs to be updated as provided for in the law on public service concessions.

At this point, taking into account the most common bus models that serve the services on campus for the three lines (DUARTE, GATTI & SILVA, 2020). The level of annual carbon dioxide emission in the order of 1,058,302.2 (CO<sub>2</sub>.Kg/Year) was estimated using the top-down method, where energy use was considered. It can be seen that line 2 has greater participation in the levels of emissions generated, something around 63.8%, even though it is not the one that circulates the most, in the case of integration (Fig.02). Although not even a survey has been made, it can be observed that certain groups of students walk on campus, something around a kilometer, equivalent to the entrance of the southern sector. The profile of the academics was observed, because of the use of another mode of transport, who believe that if there were infrastructure, it would be possible greater adherence to the use of vehicles such as bicycles. Because they do not know how scooters work, the modality had low adhesion on the Manaus campus.

It should be added that the city has no infrastructure for these types of vehicles. At this point, the university space could be a pilot for other points in the city.

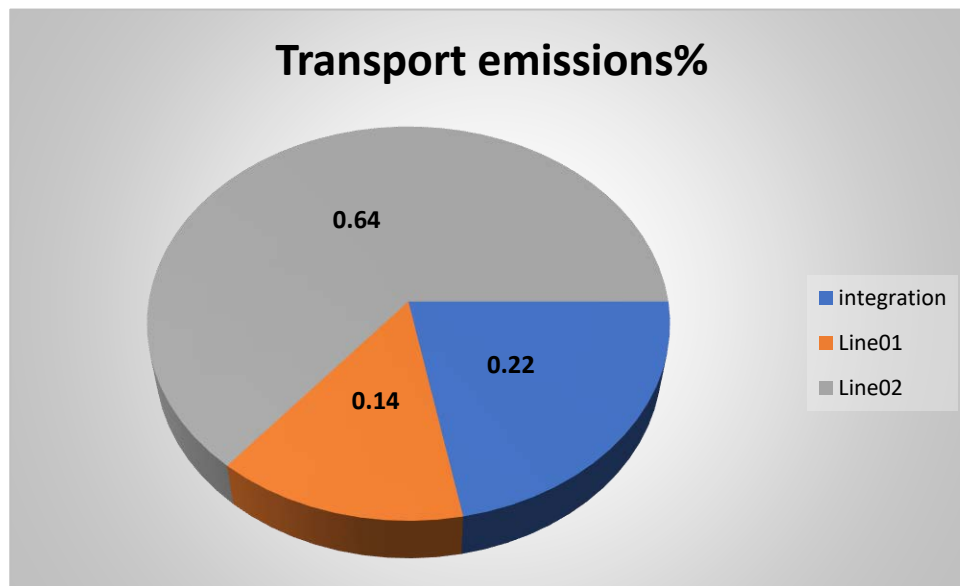


Figure 2: Transports Emissions participation of the campus

Source: The author

#### 4. Applied methodology

The development of the project includes a bibliographic survey in all its phases, questionnaires were prepared to collect data in the form of field research. As for the questionnaire application strategies, two were used, one for sending electronic forms and the other for interviewing different types of the target audience. The result of the field research is what supports the activity reports and this article. In the medium term and the long term, it is expected that the opinions and results observed in the study will be the basis for implementing a sustainable mobility model in the campus environment. Together with the first phase of the research, a study was developed to find out how much emissions are generated in the mobility system that is performed by the public transport model. This study applied the top-down method to estimate the

annual carbon emissions of the model adopted in three steps: Calculating energy consumption, calculating the amount of carbon, and the CO<sub>2</sub> emissions generated.

The project has a multidisciplinary format assuming an exploratory, descriptive, and applied form. Thus, as one of the objectives of the project is to improve ideas, make discoveries and model analyzes, part of the project to be carried out will be in the form of exploratory research, using other methodologies such as the descriptive one to study the profiles of the various groups involved. Regarding data collection, a total of 511 (five hundred and eleven) people from the university were interviewed. The collection of data had two phases: In the first phase, the questionnaires had as objective to raise the data of the System and profile of the users. At this stage, the questionnaires were sent in an electronic format. In the second phase, the forms were aimed at evaluating alternative modes of transport that would satisfy the academic community. Here, the field research was carried out in the physical spaces of the University. Using an electronic form, the main target audience was the students, of whom 96% of the interviewees were reached. As already reported, the University is divided into two sectors, being north and south. 56% of those who participated in the survey, transit between these sectors. When entering the campus of UFAM-

Manaus, to reach the northern sector, one travels approximately three kilometers and to the southern sector, one-third of that. The survey showed that 76.7% of respondents would agree to travel up to one kilometer on the campus by bicycle or scooter. However, the use of scooters was very low. It was noticed when interviewing the students, that this fact may be related to the little knowledge about how to use this type of transport modal in the region. On the other hand, 38.9% of respondents confirmed that if there was infrastructure, they would use bikes for your mobility on campus.

The study considered the use of shared vehicles and the use of applications by campus students (Fig03). It was observed that approximately 19% of students use vehicle services for applications three or four times a week. Using application vehicles has a contribution regarding the issue of land use, in some cases, these vehicles are shared between one or more colleagues. With the second phase of the study, it was observed that the flow on the campus is greater towards the north zone of the campus. This is because in the north of the campus, services that are not found in the south, are offered, such as bank agents and it is where most academic centers are concentrated.

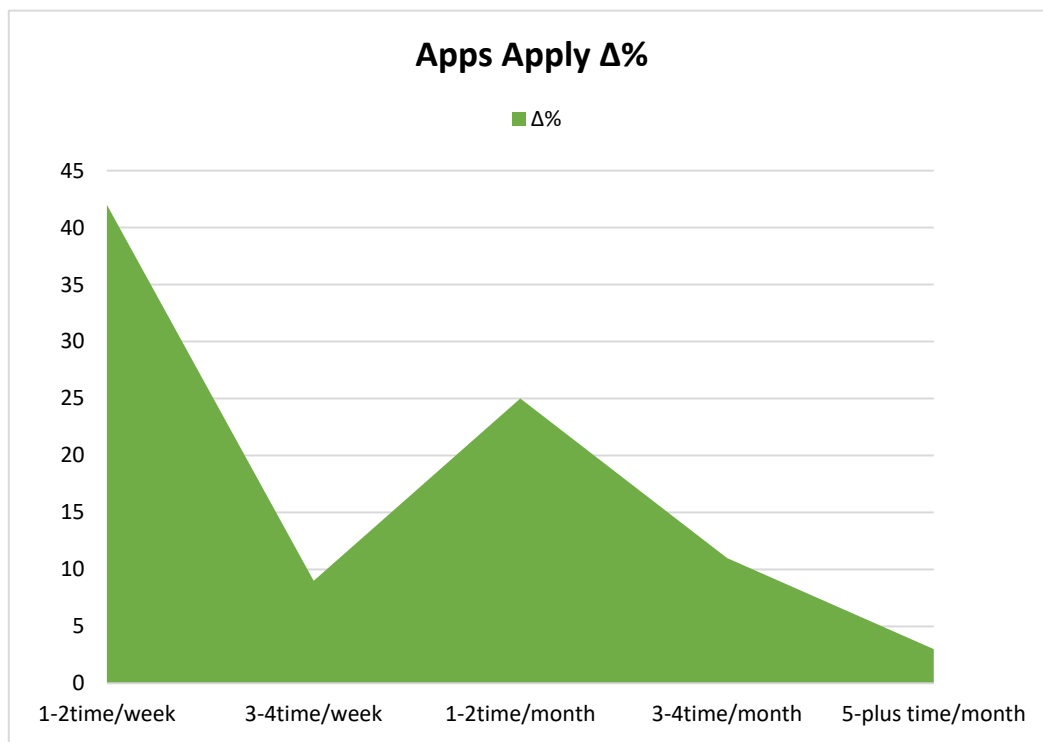


Figure 3: Shared Vehicles

Source: the author

## 5. Applied Discussion and Expected Results

Presenting a proposal for sustainable mobility on the university campus in a way is an activity that demands a governance practice since the Federal University of Amazonas/UFAM is a federal public organization. Thus, it is expected to mobilize the sector's stakeholders in ways that another mobility modality can be implemented to serve the internal space of the campus. And here it will be necessary to dialogue with industries, engineering, and architecture institutions as well as groups from the university itself to implement the proposed changes. Here you can insert an innovative model while having the current and in the long term change the mobility system in operation looking for a more eco-efficient format and better service level. Thus, the proposal must have medium-term and long-term actions to have effective results. Research has shown that there is a possibility to improve the energy performance of the transportation system on campus, making the system more eco-efficient. To this end, some proposals can contribute to reducing negative externalities in the medium and long term. In the current situation, the use of bicycles is very low, research has shown that it reaches less than 4%. However, it is believed that by implementing an infrastructure that guarantees safety in bicycle mobility, together with command and control processes this mode can be further stimulated. Some studies attest that offering other transport modal alternatives can make the system more flexible and sustainable.

It was possible to observe that implementing another transport model, making mobility more flexible and sustainable, was not a very simple task in the other cases observed and certainly in the Amazon region will be no different, not least because this involves changes in behavior and even changes in culture. To begin, we must outline a plan for the long, medium and short term, where in the short and medium-term, there is

the question of removing barriers, as already mentioned.

To work on sustainability and energy use, we have to first working physical barriers, these being:

1. Apply cycle path infrastructure over one kilometer
2. Implement bicycle terminals
3. One kilometer reduction in bus routes where travel originates on campus

These actions can be implemented in the short and medium-term as they are simpler, making it possible to improve and extend innovative solutions on campus in the long-term. Applying the bike path infrastructure over a kilometer, as observed in research, people have a certain predisposition to use bicycles in a distance of up to a kilometer, this was also observed in the study carried out on campus, it is expected that there is a good adherence, as shown in the study developed, 76.7% of students would adhere to the modal. Thus, using motivating measures, initially, as well as command and control, this action will be promising.

Implement terminals for bicycles, here the question of positioning must be considered, as well as the practicality and technology to be adopted, to make the model accessible to students and teachers within the campus.

One kilometer reduction in bus routes, if the region's transport matrix is considered to be the same, this measure will reduce emissions generated in the trip, as well as generate externalities positive in the environmental and social sphere, therefore sustainable.

### **5.1 Expected results**

It is expected that there will be an inversion in the flow of influence of mobility, where instead of the transport model and the form of urban mobility it will influence the system of university mobility, often generating negative externalities. The university and those who pass generate positive externality and influence urban mobility plans. Even if the physical barriers are removed, cultural issues may have to be worked on, since in the region it has never carried out this type of mobility.

## **6. Referencias**

- 1.BRASIL. Lei nº 8987 de 13 de fevereiro de 1995. Dispõe sobre o regime de concessão e permissão da prestação de serviços públicos previstos no art175 da CF/88
- 2.BRASIL. Lei nº10.257 de 10 de julho de 2001. Regulameta os artigos 182 e 183 da CF/88, estabelece diretrizes gerais da política urbana e dá outras providencias
- 3 COHEN,A., SHAHEEN, S.A.;. (jul. 2016). *Planning for Shared Mobility*. American Planning Association-APA.
- 4.KEHINDE, Aluko Oluwakemi(2019); A review of urbanisation and transport challenges in developing. *International Journal of Innovation Education and Research*. Vol-7,Nº04.
- 5.MONT,O.,PALGAN, Y.V.,BRANDELEY,K.,ZVOLSKA,L.,(2020); A decade of the sharing economy. Concept, users, business and governance perspectives. *Journal of clean production*.
- 6.RIVAS, A. (2014). *Economia e valoração de serviços ambientais utilizando técnicas de preferencias declaradas*. Manaus-AM,: Editora da Universidade Federal do Amazonas-EDUA.



- 7.SAVAN, B., COHLMeyer, E., & LEDSHAM, T. (2017). Integrated strategies to accelerate the adoption of cycling for. *Transportation Research*, pp. 236-249.
- 8.SLACK, N., BRANDON-JONES, A., & JHONSTON, R. (2018). *Administração da produção*. ATLAS.
- 9.PROEG-Pro-Reitoria de Ensino e Graduação disponível em: <https://proeg.ufam.edu.br/apresentacao.html>  
Acesso em 31/10/2019
- 10 OECD. (2012). *Measuring the Potential of Local Green Growth: An analysis of Grather Copenhagen*. *Organisation for Economic Co-operation and Development*. OECD.
- 11.AZZALI,S.;SABOUR,E.A.(2018); A framework for improving sustainable mobility in higher education campuses: The case study of Qatar University.Case Studies on Transport Policy-6 pg(603–612)
- 12.ALLEN,J.;FARBER,S.(2018);How time-use and transportation barriers limit on-campus participation of university students.Travel Behaviour and Society 13,pg (174–182)
- 13.CASTRO,D.B.,PINTO,F.R.,ALENCAR,D.B.,SILVA,R.(2019).Adaptation of Leopold Matrix for assessment of Environmental Impacts Caused by the flower avenue project in Manaus City-Amazonas.International Journal for Innovation Education and Research.Vol.7No11.Pag(517-525).
- 14.3.KAPLAN, H. (March de 2015). Transportation sustainability on. *International Journal of Sustainability in Higher Education* , pp. 173-185.
- 15.DUARTE, F.H.P.,GATTI, A.P.,SILVA, W.A.M.(2020). Mobilidade Universitaria: Um estudo de caso da Universidade Federal do Amazonas,Cap.09. Gestao da producao em foco. Vol.42/ Belo Horizonte-MG.

## **Inclusion, physical activity and quality of life for people with disabilities**

**Luis Henrique Almeida Castro (nutricao.luishenrique@gmail.com)**

PhD in the Health Sciences Graduate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**Diego Bezerra de Souza**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Fernanda Viana de Carvalho Moreto**

MSc., Nutrition, Food and Health Graduate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**Nelson Thiago Andrade Ferreira**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Juliana Vicente de Souza**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Aline Ortega Soloaga**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Raquel Borges de Barros Primo**

PhD in the Health Sciences Graduate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**Geanlucas Mendes Monteiro**

Health and Development in West Central Region Graduate Program, Federal University of Mato Grosso  
do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Ygor Thiago Cerqueira de Paula**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Vanessa de Souza Ferraz**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Júlia Arruda de Fonseca Palmiere**

Master's Program in Health Psychology, Don Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Cristiane Martins Viegas de Oliveira**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Abstract**

*Several social spaces have been attended by people with disabilities. The universities include some of them, in this context we point out the Don Bosco Catholic University, in which through the University Extension Project Vida Nova, mainly serves people with spinal cord injuries with physical activities and resistance exercises. At the head of the project are coordinating teachers and students, with participation from the Physical Education and Nutrition courses. After the anamnesis, the training routines are elaborated, attending the requirements and limitations of each person. The objective is to present the work of adapted exercises carried out in the project with the members with physical disabilities. Seven individuals participate in the project in the morning, two of them female and five male, with ages between 24 and 61, an average of 44.85 years. Currently, the project serves around 15 people with physical disabilities, having the thera band as the most used means of adaptation. Future studies on the implementation of adapted gyms can be carried out, considering the interdisciplinary relevance of the theme, which in addition to involving courses in the health area, can cover other areas such as engineering and exacting for floor plan making and budgeting.*

**Keywords:** Human Rights; Muscle Strength; Paraplegia; People with Disabilities; Resistance Training.

**1. Introduction**

According to the World Health Organization(2012), more than one billion people live with some form of disability, and about 200 million have considerable functional difficulties. Data from IBGE (2010) show that 23.9% of the population in Brazil have some form of disability, 25.73% of these classified as people with motor disabilities. A more alarming number is that, even without official data, it is estimated that only 10% of this population practices some type of regular physical activity (SOLERapudSERON, ARRUDA and GREGUOL, 2015).

Contrary to other historical moments, an increase in the number of people with disabilities attending social spaces can be observed at the present time. This achievement was acquired through struggles that guaranteed their democratic rights as citizens. In this scenario, the National Congress approved through

Legislative Decree 186 of 2008, the text of the Convention on the Rights of Persons with Disabilities and its optional protocol, signed in New York City on March 30, 2007. It points out (REQUIÃO, 2016) that the Statute brings numerous guarantees for people with disabilities of all types.

In sequence, Brazil besides the Convention with weight of constitutional norm, approved the Brazilian Law of Inclusion of the Person with Disability, better known as the Statute of the Person with Disability (Law 13.146/2015). It declares Manica (2017), that the Convention favored the basis of the Statute, and deals with the person with disability covering countless places of coexistence, attesting the acquired rights, which results in new opportunities for better quality of life, health, independence, and promotion of affirmation of people with disabilities. In this regard, it is important to observe some precepts established in the Statute, among them, Art. 105, § 2, in which it recognizes the person with disability when interacting with one or more barriers, which may prevent his/her full participation in equal conditions with other people.

Moving forward in the Statute, Art. 18 presents the guarantee of total care to the health of the person with disability guaranteeing full access to all, which is corroborated by Art. 6 and Art. 196 of the Federal Constitution of 1988, which elucidates health as a right of all and a duty of the State. Subsequently, Art. 43 brings the promotion and participation of the person with disability in cultural, sportive and recreational activities by the public power, affirming the accessibility to event venues and the participation of people with disabilities in games and leisure sports activities, even in school environment, in total equality with other people. Farias, Cunha and Pinto (2017), concludes that the objective of the law, therefore, is to provide access to culture, sports and leisure for people with disabilities in order to eliminate any type of discrimination. Although this project is structured in a bias towards the practice of physical activities for a better quality of life, we emphasize the issue of sports practice and the opportunity of access for people with disabilities, in which several infra-constitutional laws describe it. As an example, Law 10.891/2004 that establishes the Institution of the Athlete's Scholarship, for athletes with high performance in the Olympic and Paralympic modalities.

It is important to point out here the Art. 217 of the Constitutional Charter, which indicates as the duty of the State to favor sports practices as a form of law for each one, noting also in its paragraph 3 that the Public Power should stimulate leisure, as a form of social promotion. Besides, it presents the Convention on the Right of Disabled People in its Art. 30, in item one that attests to the States parties, the right of disabled people to participate in cultural life in equality to other people. In item five, letter "a", which establishes the duty of the States parties to encourage and promote participation in sports activities for people with disabilities. Consecutively in the following items, allow access to sports and recreational events; and allow access to services provided by people or companies involved in the organization of recreational and sports activities.

Among these spaces are the universities, which as a social and training space, have participated in the construction, preparation and dissemination of knowledge about disabilities and in the work that can be developed with people who are born with some kind of disability, or acquire it throughout life. It is within this context of care for people with disabilities that we highlight the Don Bosco Catholic University (UCDB), which through the New Life University Extension Project (PEUVN), offers among other activities to this population, also a work directed to exercises with weight, which attends in its majority individuals with spinal cord injury, who present paraplegia and tetraplegia in the members.

Based on these considerations, the present study aims to present the work of adapted exercises carried out in the PEUVN with members who have physical disabilities. We use the term adapted in this study from the concept given by Winnick (2004, p.04) that uses it in the “sense of adjusting, modifying, shaping”, and that in the project in which the study was carried out, refers to the modification of teaching methods, the adaptation of the apparatuses in the performance of exercises, bringing them closer to weight training in order to work on the same muscle groups, but performed with other materials, among other adaptations that will be used during the work.

## **2. People with physical disabilities and adapted physical activity**

The adapted Physical Education is a subject of the UCDB graduation course in Physical Education, where the study was developed. This discipline was inserted in higher education based on the proposal of the United Nations (UN) World Organization when it instituted 1981 as the International Year for People with Disabilities in order to promote changes in attitudes towards people with disabilities (SILVA, 1986). The discipline was inserted with the purpose of working on issues related to physical activities and sports for people with disabilities.

To work with these people it was necessary to know the types of disabilities and their origins. As in this study we will deal only with physical disability, at this moment we bring Gorgatti eCosta (2005, p. 218) who conceptualizes the physical (or motor) disability as that which refers “to osteomuscular problems or the function of the body, interfering in motricity. It is characterized by a disturbance in the structure or function of the body, which interferes with the movement and/or locomotion of the individual”.

From ancient times, there is information that people with disabilities practice physical activity, however, going deeper into the subject, as for competitive activities, these are still recent. Data from the last 20 years, athletes with physical disabilities have presented important results compared to the levels of people without disabilities. Besides being a therapy, the sport for the person with disability goes towards high performance in search of a better training technique for each athlete, becoming of great importance to obtain good results (GORGATTI and BOHME, 2017).

According to Miarka (2017) when athletes with disabilities are accepted and considered at competition levels, inclusion becomes a final stage in the approach of athletes when they are able to approach without fear or preconceptions of being judged, which promotes inclusion, with greater possibility of it occurring, when the sport is adequate, when there is motivation and interest of members.

As for the assessment instruments in the area of sports and physical activity adapted for people with disabilities, few are the instruments to be used that take into account the specificity of each disability. What usually occurs is an adaptation of the available resources used, which is often without the necessary care for people with disabilities (GORGATTI and BOHME, 2017).

The project participants, subjects of this study, have a physical deficiency resulting from injuries that occurred in the marrow, which we call spinal cord injury. Spinal cord injuries can be categorized into non-traumatic (hemorrhages, tumors, virus infections, among others) and traumatic (events related to traffic accidents, assault with a firearm, work, daily life and leisure), although they can still be qualified as complete when there is no voluntary movement below the level of the spinal cord injury, and incomplete

when there is voluntary movement or sensitivity below the level of the spinal cord injury (WINNICK,2004). These circumstances are increasingly evident in everyday life, given the increase in the number of cars and motorcycles circulating in cities today, and the change in the pace of people's lives, which leads them to move from place to place in a reduced time. It is in this way that the incidence of these types of trauma has increased in the population that configures the most recurrent causes of spinal cord injuries (SOUZA 1994; NASCIMENTO and SILVA, 2007; BORTOLLOTTI and TSUKAMOTO, 2011, BAHIA, 2015).

According to Souza (1994); Nascimento e Silva (2007); Muttiet al2010); Bortolloti and Tsukamoto (2011) and Bahia (2015), traumatic spinal cord injuries with irreversible damage to the spinal cord and nerve roots affect the individual's sensory-motor functions, causing social and economic consequences to the patient and his family. Still regarding the denomination within spinal cord injuries, tetraplegia and paraplegia are considered the most common types of spinal cord injuries, in which in tetraplegia all limbs and trunk are affected and in paraplegia there is a reduction or loss of motor function and/or sensory function of the thoracic, lumbar or sacral segments of the spinal cord. In this case, the upper limbs remain intact, but depending on the level of the injury, it may affect the function of the trunk and pelvic organs - urinary system, intestinal – as well as the respiratory, circulatory, sexual and reproductive systems.

From the point of view of Souza (1994); Nascimento e Silva (2007); Muttiet al2010); Bortolloti and Tsukamoto (2011) and Bahia (2015) there is also an incidence of other sequelae besides physical and sensory dysfunction, the person with spinal cord injury may present atrophy of the musculoskeletal system, metabolic, hormonal and neuromuscular alterations, such as spasticity, hyperreflexia or hyporreflexia of the autonomic nervous system. As for the respiratory capacity, there can be, reduction, as well as the blood circulation and the dimensions of the cardiac structures. All these aspects associated with sedentariness can stimulate cardiovascular and respiratory diseases, which limits physiological responses to motor activity, leading to rapid fatigue.

In addition, homeostatic and adaptation mechanisms that are responsible for people's natural health can occur. Physical fitness and functional independence – relevant aspects in the life of the person with spinal cord injury – end up being impaired as the degree of afferent and efferent spinal cord injury extends, consequently there will be less muscle mass available for physical activity (SOUZA 1994; NASCIMENTO e SILVA, 2007; MUTTIet al, 2010; BORTOLLOTTI e TSUKAMOTO, 2011; BAHIA, 2015).

Faced with the changes resulting from the spinal cord injury, the knowledge about this before the practice of any physical activity becomes essential due to the risk that practitioners may expose themselves to both fractures and cardiovascular overloads. This knowledge can guide the elaboration of a program of physical activities, the quantification of the loads and also the elaboration of a program of health education.

### **3. Resisted exercises for people with disabilities**

Individuals with spinal cord injury, temporarily or not, need extrinsic assistance to perform certain movements, such as displacement, since most of them are wheelchair users or even individuals who have some walking pattern, which requires the use of objects to support themselves as canes or walkers. With this, a progressive overload in their upper limbs may occur, and consequently joint wear and muscle injuries, which may limit and damage their independence and rehabilitation (BAHIA, 2015).



According to Bortolloti and Tsukamoto (2011) in the last decades there has been a significant expansion in the survival of spinal cord injury patients due to advances in medicine. Thus, rehabilitation treatments are aimed at maximizing the individual's functional independence and reintegration into society, working on the inclusion of factors such as prevention of deformities and complications, increase in remaining muscle function, respiratory function, transference and replacement of postures, wheelchair handling, balance, acquisition of orthostatism and possible return of walking with orthotic apparatus. These factors are inherent to the paraplegic spinal cord injury, associated with the several activities he performs in his routine, such as lying down and getting out of bed, getting in and out of the car, going to the bathroom, changing clothes, among others.

Thus, it is important to add to these advances and knowledge, that the individual performs sections of muscle strength training that allows the evolution of improvement in his physical fitness. Among the several trainings, the practice of exercises with weights or weight training (most commonly used term) stands out in this work, allowing the improvement of the individual's daily activities, activities that can be called functional independence, which is directly linked to the preparation of all preserved muscles in the spinal cord injury, as well as the improvement in the predisposition to the risk of cardiovascular diseases, improvements in social living, psychological well-being and quality of life (BORTOLLOTTI and TSUKAMOTO, 2011), (MEDINA, BOTARO and OLIVEIRA, 2012).

#### **4. Resisted exercises and their benefits**

As for the benefits of physical activity for people with disabilities, we can present not only the promotion for a better quality of life and functional independence, but also an essential component when it comes to reducing public health expenditures ( RIMMER et al., apud SERON, ARRUDA e GREGUOL, 2015)

In this sense, Soares and Blascovi-Assis (2018), there are several benefits brought by the practice of sports activity that aim to overcome negative situations, so that everyone can effectively participate in society, which aims at identification in the social environment, and which enables the development of self-esteem, of how the person with disability affirms himself/herself, how he/she determines his/her independence and social interaction.

Studies by Bortolloti and Tsukamoto (2011) have shown that paraplegic people performing exercises with weights have obtained a significant improvement in muscle strength. In them, the test of 1 RM (maximum repetition) was used as a training protocol to obtain the results. With this, they concluded that after 7 weeks of regular training, the individuals showed strength gain in the upper limbs, and that muscle strengthening produces a better response in trainings carried out 2 to 4 times a week in healthy individuals, being necessary to work an intensity of resistance that allows the execution of 8 to 12 repetitions, and now have an increase in the rate of muscle gain if the intensity of exercise and/or training increases (more weight and fewer repetitions). Through the 1 MRI test it is possible to obtain the result of factors such as muscular strength behavior in different muscle groups, effectiveness or not of regular physical activity programs to increase muscular strength, prescribing the intensity to be applied in exercises with weight, among others. In a literature survey conducted by Mutti et al. (2010), aspects such as muscle strength and endurance, functional capacity, independence and quality of life incorporated some of the benefits granted by resistance

exercises, as well as increased capacity to perform activities of daily life and correction of muscle imbalances that occur with chronic wheelchair propulsion. Studies were also found informing an improvement in the psychological and social issues of paraplegics, where after 1 year of conducting a resistance exercise program in 4 men who use wheelchairs, the results of the analysis of the interviews pointed out positive changes in self-confidence and body image and that resistance exercises promoted opportunities for socialization.

Another study conducted by Nascimento Silva (2007) shows that after spinal cord injury there is a decrease in muscle mass instead of inactivity, and the practice of physical activity promotes improved muscle strength, coordination and endurance, decreased negative psychological reactions such as depression, mental inactivity and social isolation, infectious complications of the urinary tract, bedsores and hospitalizations, improved functional independence and mood.

A study with 2 paraplegics and 1 tetraplegic through an upper limbs cycloergometer tried to evaluate the cardiovascular and respiratory conditioning of patients before and after the 6-week training period, twice a week. The results showed that there was an increase in inspiratory pressure of 40% for the cervical spinal cord injury, 53.4% for the thoracic spinal cord injury and 20% for the lumbar spinal cord injury. There was also an increase in forced vital capacity and forced expiratory volume in the first second in quadriplegic and paraplegic patients at thoracic level. Moreover, physical exercise generates an improvement in cardiorespiratory parameters, promoting an increase in work capacity of 40% and maximum oxygen volume of 20%. Regarding the functional independence and quality of life of the patients, there were no changes, and despite this, the exercises of this specificity become relevant in the life of the spinal cord injured, since the inactivity compromises the cardiorespiratory system (JUVENAL and SAVORDELLI, 2016).

From the presentation of some studies carried out with the population we work with and with whom we direct these studies, we will present the extension project that represents all the work, place, participants and activities of this study.

## **5. Materials and methods**

This research has a methodological case study bias, reporting experiences in the PEUVN and their contributions to the community served and the academic participants through teaching and research. The authors of this research developed the activities in the morning period. Seven individuals with physical disabilities participated in the project during this period, two of them female and five male, living in the city of Campo Grande - MS. Three of them present tetraplegia, two paraplegia, one hemiplegia and one with neuromotor deficiency performing walking at short distances. The age of the participants is between 24 and 61 years, with an average of 44.85 years.

These are people with physical disabilities resulting from automobile accidents, firearms, diving and head trauma due to confrontation with another individual. That is why we think about actions in the project that, through physical activities, can contribute to the independence and autonomy of the participants, promoting conditions so that they can return to participate and enjoy with quality and safety their social coexistence. The service starts with the filling out of a form as soon as they enter the project. One of the academics

receives the participant and after a brief dialogue and interview, writes down the information on the anamnesis form. This procedure consists of identifying the participant's profile, information regarding his/her functional independence, how his/her physical disability occurred, and the data that subsidizes the preparation of the training form. After the preparation of the training form, the practice begins with the execution of the exercises.

Bodybuilding exercises are worked in adduction, abduction and adduction, horizontal shoulder abduction, bending and extension of shoulders and elbows, isometric exercises with breathing to activate muscles in the region of the core and stretching, made both with common devices of the gym as with alternative devices, and adapted materials such as shin guards, theraband, dumbbells, among others. The participant, with walking ability, works exercises of lower limbs for the quadriceps and ischiotibial muscles, in the extension chair and flexor chair

In the case of those with tetraplegia, there is a type of adaptation in the hands with a type of leather glove, possessing a ring that is attached to the karabiner of the devices, and the use of the theraband is one of the adaptations that allows the execution of exercises of upper limbs and back. With only one band of the theraband it is possible to work large muscle groups and adapt the band on the hands or arms to perform strength exercises. For those who present paraplegia there is no need to use the gloves, but the theraband is also used, mainly in exercises for joint movements.

Some classes are recorded with footage and photographs for monitoring the training program, for example, in the case of one of the participants, quadriplegic, whose physical exercise program aims to minimize the postural problem, installed in the cervical and thoracic spine due to his condition as a wheelchair user and loss of waist movements down.

## **6. Results and discussion**

The Vida Nova extension project has among its objectives to offer physical activities, among them resistance exercises, to people with disabilities, taking academic knowledge to the service of the community and expanding the process of inclusion of these people in society. There are other objectives in the project, such as contributing to the academic formation in the area of adapted physical activity and contributing to the social inclusion of people with disabilities, providing greater autonomy and physical independence to the people with disabilities served in it.

For a better quality of care for the people with disabilities in the project, often with several kinds of limitations, one or more academics are responsible for each one of them. The participating academics can assist in the Project since the first semester, and for that they receive adequate training from the coordinating professor, because not all of them still have theoretical and practical knowledge of the proposed activities for people with disabilities.

Currently, the project offers sports initiation and psychomotricity classes for young people and adults with intellectual disabilities, weight training for a diverse public, among them blind people, people with physical disabilities (congenital malformation, brain trauma and spinal cord injury) and intellectual. Classes are held on Tuesdays and Thursdays, lasting 40 to 60 minutes per student, with morning and afternoon hours.

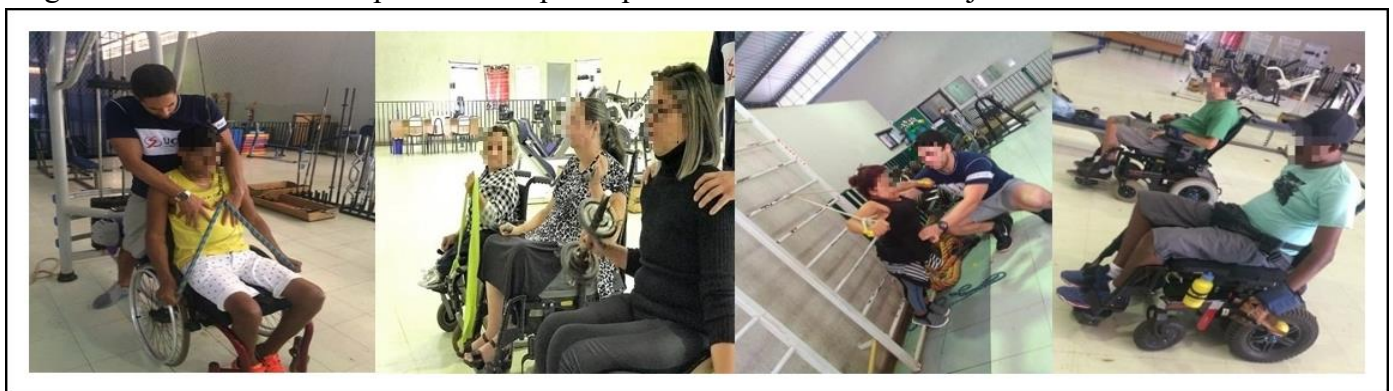
The coordinators of the New Life Project were teacher Joslei Viana de Souza who created it, teacher

Marcela Grisólia Grisoste, teacher Flávia Faissal de Souza, teacher Sarita de Mendonça Bacciotti and since 2014 is coordinated by teacher Dr. Vera Lícia Souza Baruki. The project has a Physical Education teacher as coordinator and academics of the UCDB Physical Education course, scholarship holders and volunteers of the Physical Education course (Degree and Baccalaureate) who perform the work with people with disabilities. The project team also includes a teacher and an academic scholarship holder from the Nutrition course of the same institution. There is also a social worker responsible for all the extension projects inserted in the UCDB school clinic. The work begins after the referral made by the physiotherapy sector of the UCDB's clinic school or by the physiotherapist of the SUS who attends inside the institution. Each person with disability has specific training that considers their type of disability, their limb commitments, and their possibilities of strengthening, improving their postural condition, and joint mobility.

Regarding the academics who are at the forefront of the activities, the project makes it possible to put into practice all the theoretical-practical knowledge learned in the classes of the Physical Education course. In it, the Physical Education teacher will also face different challenges not only related to disability, but also to educational, social and cultural aspects, and in order to overcome them, this teacher must have a posture not only participatory, but also critical. The extension activities allow the academic to exchange and gain experience, where it is possible to teach and learn from the people with whom one works.

Weight training for people with spinal cord injury began on May 3, 2011 after the Physical Therapy sector of the Clínica Escola at UCDB proposed that the Vida Nova Project continue the work. A partnership was established between the Physical Therapy sector and the Physical Education sector, in which the Physical Therapy sector referred patients who needed to gain strength so that in the Vida Nova Project this work could be developed. Upon entering the project, this individual is treated as a student and no longer as a patient. In the Vida Nova Project we have as a goal the gain of strength and localized muscular resistance (RML) for people with spinal cord injury. In addition to weight training equipment, we use resources such as thera band, teratubling and a lot of creativity. Figure 1 presents images of the work done with the PEUVN students. Periodic anthropometric evaluations are performed, which include perimeter and skin fold measurements, as well as nutritional orientation with a scholarship student from the Nutrition course.

Figure 1 – Activities developed with the participants of the Vida Nova Project.



Source: Own elaboration.

## **7. Final considerations**

The Brazilian Law of Inclusion to the Person with Disability, Law 13.146/2015 was a great advance in the politics of inclusion in the Country, what corroborated the Constitutional Letter that came in 1988. However, it is observed that there is a long way to go in the search for such rights to be effectively fulfilled.

The project presented in this work, meets the fulfillment of the constitutional precepts exposed and the harmonious search for human rights. Currently, this project serves around 15 people with physical disabilities, and in the morning the concentration of participants is higher. Six of them arrive in motorized wheelchairs and others in common wheelchairs. The activities are carried out at the School Academy, which when it was designed and at the time of acquisition of the equipment, did not count on the participation of people with disabilities at some time. As we have already reported in this study, people with disabilities have currently increased and attended more social spaces, one of them is the Vida Nova project within UCDB.

This situation led scholars to add to their knowledge of the subject Adapted Physical Activities, the study of the physical space of the gym and the apparatuses to explore new possibilities for wheelchair students, with paraplegia and tetraplegia, to perform muscle strength training. At the same time that they observed the gym's apparatuses, they created the exercises with the use of the thera band.

The strength training was applied individually, considering the need and characteristics of the injury of each participant positioned in his wheelchair. Only exercises for upper limbs were performed, and if there was a postural alteration during the execution, the academics made the correction verbally.

The structure of the gym does not allow the full use of the devices, but the use of the thera band with quadriplegic individuals in weight training exercises was one of the adaptive procedures that can be applied in case of lack of accessibility in the gym or for participants who do not have prosthesis or hook to perform the training.

However, future studies may be developed regarding a school gym with adapted equipment to better serve them. This possibility has already been portrayed to the responsible teachers and obtained a good acceptance, because it was observed beyond the contribution to the students, the interdisciplinary relevance that the project can provide, establishing relationships beyond the health courses, with the courses of engineering for surveying and making of floor plan, as well as courses such as accounting sciences and administration that will make the budget for the implementation of the academy and make it accessible and adapted.

## **8. Competing Interests**

The authors declare no competing interests.

## **9. References**

BAHIA, Daniel José de Faria. Strength Training for Higher Individuals with Spinal Cord Injury Sequels: Attention of the Physical Education Professional in the Family Health Program. Course Conclusion Work Family Health Strategy Specialization, Federal University of Minas Gerais, Belo Horizonte, 2015.



Available at: < <https://www.nescon.medicina.ufmg.br/biblioteca/imagem/6037.pdf>>. Access on: 29 Jun. 2018.

BORTOLLOTTI, Lígia Franciele; TSUKAMOTO. Heloísa Freiria. Effects of Physical Training on Muscle Strength in Paraplegics. *Neuroscience Journal*, Apucarana, v. 19, n. 3, p. 462-471, 2011. Available at: < <http://www.revistaneurociencias.com.br/edicoes/2011/RN1903/19%2003%20relato%20de%20caso/518%20rc.pdf>>. Accessed on: 29 Jun. 2018.

BRAZIL. Ministry of Planning, Development and Management - Brazilian Institute of Geography and Statistics. People with disabilities: adapting spaces and attitudes. Demographic Census 2010. Available at: < <https://agenciadenoticias.ibge.gov.br/pt/2012-agencia-de-noticias/noticias/16794-pessoas-com-deficiencia-adaptando-espacos-e-atitudes.html>>. Access on: 14 Jul 2018.

FARIAS, Cristiano Chaves de; CUNHA, Rogério Sanches; PINTO, Ronaldo Batista . Statute of the person with disability commented: article by article. Editora Juspodivm, 2017.

GORGATTI, Marcia Greguol; COSTA, Roberto Fernandes da. Adapted Physical Activity: Quality of life for people with special needs. Barueri, Manole, 2005.

\_\_\_\_\_. BÖHME, Maria Tereza Silveira. Scientific authenticity of an agility test for individuals in wheelchairs. *Revista Paulista de Educação Física*, v. 17, n. 1, p. 41-50, 2017.

JUVENAL, Eliane Alves de Oliveira; SAVORDELLI, Claudia Lunardi . The Effectiveness of the Cycloergometer in Cardiovascular Conditioning in Patients with Spinal Cord Injury. *Revista da Sociedade Brasileira de Clínica Médica*. v. 14, n. 3, p. 151-158, jul/set, 2016. Available at: < <http://docs.bvsalud.org/biblioref/2016/10/2127/151-155.pdf>>. Accessed on: 26 jun. 2018.

MANICA, Loni Elisete. Formal and non-formal professional education for people with disabilities in Brazil. *Revista Ibero-Americana de Estudos em Educação*, v. 12, n. 4, p. 1998-2023, 2017.

MEDINA, Géssica da Silva; BOTARO, Clarissana Araújo; OLIVEIRA, Jaqueline de Freitas . Physical rehabilitation in the spinal cord injury: case study. *Scientific Journal of Faminas. Muriaé*. v. 8, n. 3, p. 85-92, sep/dez, 2012. Available at: <http://periodicos.faminas.edu.br/index.php/RCFaminas/article/view/305/281>>. Access on: 29 Jun. 2018.

MIARKA, Bianca et al. Paralympic, adapted judo and its conditions of coexistence. *HORUS*. V. 6, n.1, p. 225-234, 2017.

MUTTI, Luciana Campos; SALLES, Belmiro Freitas de; LEMOS, Adriana; SIMÃO, Roberto. The Benefits of Resisted Exercises in the Improvement of Functional Capacity and Health of Paraplegics.



Revista Brasileira de Medicina do Esporte, v. 16, n. 6, p. 465-470, nov/dez, 2010. Available at: <<http://www.scielo.br/pdf/rbme/v16n6/a14v16n6.pdf>>. Access on: 26 jun. 2018.

BIRTH, Luciana Gomes do; SILVA, Sabrina Maria Leite da. Benefits of Physical Activity on the Cardiorespiratory System as well as on the Quality of Life of Spinal Cord Injury Patients: A Review. Revista Brasileira de Prescrição e Fisiologia do Exercício. v. 1, n. 3, p. 42-50, May/Jun, 2007. Available at: <<file:///C:/Users/User/Downloads/26-90-1-PB.pdf>>. Access on: 29 Jun. 2018.

REQUIÃO, Maurício . The changes in capacity and the inclusion of decision making supported by the Statute of the Person with Disability. Revista de Direito Civil Contemporâneo, v. 6, p. 1-17, 2016.

SERON, Bruna Barboza; DE ARRUDA, Gustavo Aires; GREGUOL, Márcia. Facilitators and barriers perceived for the practice of physical activity by people with motor disabilities. Revista Brasileira de Ciências do Esporte, v. 37, n. 3, p. 214-221, 2015.

SILVA, Otto Marques. The Ignored Epopee: the disabled person in the history of the world of yesterday and today. São Paulo, Cedas, 1986.

SOARES, Valéria Leite; BLASCOVI-ASSIS, Silvana Maria . The sport activity and its influence on the body image of the adolescent with physical disability: a study of two cases. Cadernos de Pós-Graduação em Distúrbios do Desenvolvimento, v. 11, n. 1, 2018.

SOUZA, Pedro Américo de . Sport in Paraplegia and Tetraplegia. Rio de Janeiro, Guanabara Koogan, p. 93, 1994.

WINNICK. Joseph P oseph P. Physical Education and Adapted Sports. 3 ed, Barueri, São Paulo, Manole, 2004.

WORLD HEALTH ORGANIZATION et al. World report on disability. São Paulo: SEDPcD. 2012. Disponível em: <[http://apps.who.int/iris/bitstream/handle/10665/44575/9788564047020\\_por.pdf;jsessionid=9B77449D33C77BDB066F6D9A501CD405?sequence=4](http://apps.who.int/iris/bitstream/handle/10665/44575/9788564047020_por.pdf;jsessionid=9B77449D33C77BDB066F6D9A501CD405?sequence=4)>. Accessed on: 09 Jul. 2018.

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>).

# **General Gymnastics and its Applicability in the School and Social Environment: A Bibliographic Review**

**Luis Henrique Almeida Castro (nutricao.luishenrique@gmail.com)**

PhD in the Health Sciences Graduate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**Diego Bezerra de Souza**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Nelson Thiago Andrade Ferreira**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Juliana Vicente de Souza**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Aline Ortega Soloaga**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Raquel Borges de Barros Primo**

PhD in the Health Sciences Graduate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**Geanlucas Mendes Monteiro**

Health and Development in West Central Region Graduate Program, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Ygor Thiago Cerqueira de Paula**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Vanessa de Souza Ferraz**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Lúcio Barbosa Neto**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Wesley Sebastião da Silva Moraes**

Specialist in Exercise Physiology And Sports Training, UNOPAR.  
Campo Grande, Mato Grosso do Sul – Brazil.

**Cristiane Martins Viegas de Oliveira**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Abstract**

*The subject of this paper is the history, concepts, aspects and importance of General Gymnastics. The purpose of this study was to make a synthesis of studies of doctrines and articles published in a journal, considering the relevance of General Gymnastics practice, for students within the school, and in life as to the numerous benefits it can bring. The methodology used was qualitative, with descriptive analysis. The study was supported by an integrative literature review, in which the search for scientific content was refined with the use of specific keywords related to the search theme, using the databases SciELO and Google Scholar.*

**Keywords:** Human Rights; Muscle Strength; Paraplegia; People with Disabilities; Resistance Training.

**1. Introduction**

The theme to which this work proposes is very widespread in discussions on Physical Education in schools and teaching, with regard to the preparation and experience of Teachers. General Gymnastics is a modality popularly known as Gymnastics for All, being an activity that encompasses several competitive and non-competitive modalities. Physical activities for a military training of citizens were offered during the Roman Empire, which generated strength and conditioning for young people. Among the various sports activities were jumping, running and ball games, thus configuring the gymnastics.

A brief history of gymnastics since antiquity, about 2,000 years before Christ, passing through Europe in the 19th century, will be presented in Chapter 2, also gymnastics when spread in half in the USA in 1830 by a German, starting with calisthenic processes. And finally, in 1960 the use of gymnastics devices began. Chapter 3 presents the concept of general gymnastics described as body movement, which encompasses several modalities and can be competitive or not. It is also possible to opt for the use of gadgets, choice of dress, number of participants and musical sense. Finally, the definition given by the Brazilian Gymnastics Confederation, clarifying that gymnastics can be divided into six modalities.

Chapter 4 presents Gymnastics at School, its brief history of introduction to Brazil, and teaching. It presents the authors that in order to work with gymnastics, it must be adequately trained and that Gymnastics must

be a necessary content in school Physical Education classes. The authors also affirm that gymnastics has not been much taught by the lack of experience of teachers.

In chapter 5, it is presented about Gymnastics in Life, countless benefits that it brings when practiced, brings the plurality of cultures of dances, folklore, and games, and the possibility of using various materials. And also, some objectives such as awakening joy, providing pleasure, physical and mental well-being.

In chapter 6 the methodology and the way in which this research was carried out is demonstrated, with the description of the terms used and the presentation of the databases chosen.

## **2. Methodology**

The methodological procedure used in this research was the integrative literature review, in which the searches are refined by means of descriptors related to the research theme. According to Gil (1991) they are techniques elaborated from material already published, consisting of articles, monographs, books and materials available on the Internet. Marques et al (2017) state that the bibliographic review is done through secondary data, by consulting different materials such as newspapers, magazines, encyclopedias.

The study was supported by an integrative literature review, in which searches for scientific content were refined with the use of specific keywords related to the search theme in the databases used by SciELO and Google Academic. As terms used were: General Gymnastics Concept; General Gymnastics Benefits; Gymnastics at School; History of Gymnastics; Characteristics of Gymnastics.

## **3. Brief history**

Since antiquity, gymnastics has been practiced (CAETANO, 2015). Since prehistory, the expression “gymnastics” was mentioned for any physical activity whose purpose was to organize man for his subsistence actions (FIORIN, 2002 apud CAETANO et al, 2015).

In the year 2006 before Christ, the Chinese practiced different kinds of gymnastics, called therapeutics, such as “Kung Fu”, with the objective of ensuring the immortality of the soul. Also in this sense, the Greeks sought exercises to relate mind and body, such as Socrates, Plato and Aristotle who developed physical training seeking to establish harmony and effectiveness of movements. Physical activities for a military training of the citizens were offered during the Roman Empire, which generated strength and conditioning for the youth. Among the various sports actions were jumping, running and ball games, configuring the gymnastics.

According to Werner, Willians and Hall, (2015) in Europe during the 19th Century, German Friedrich Ludwing used physical education with a political imprint in order to provide freedom, which was the milestone in the beginning of modern artistic gymnastics. The Swedish gymnastics complex used equipment such as stairs, rings and plinths. In the same sense, however, according to Souza, (1997) apud Caetano (2015) exactly in the 19th century during the Contemporary Age, that the principles of gymnastics were based on the formation of French, German, Swedish and English schools, in charge of propagating gymnastics in the world.

In the mid-1830s, Catherine Bucher shaped German gymnastics within the United States, enabling an accessible and delicate calisthenic exercise method that was performed with music. Rudolf Laban, a

German fugitive in England, stayed there with modern dance, working with body and space knowledge. In 1960, as in Germany, with wide popularity in the United States and also in other parts of the world, Liselott Diem developed programs, based on the investigation of structured scenarios with the use of gymnastics devices (WERNER, WILLIAMS and HALL, 2015).

Ramos (2008), adds that Physical Education in the 1870's was hygienic, where the concern was directed to health and personal hygiene.

#### **4. Conceptualizing general gymnastics**

General Gymnastics is a modality popularly known as Gymnastics for All, it is a body movement pointed out as a combination of other modalities of gymnastics (RAMOS, 2008).

Gymnastics is an activity that encompasses several competitive and non-competitive modalities and bypasses the practice of a sequence of movements that require strength, flexibility and motor coordination for physical and mental improvement (LAFFRANCHI B, 2001 apud GUIOTTE et al, 2015).

According to Araujo and Guzzoni (2016) general gymnastics has an individuality, which is freedom, out of step with the others that because they are competitive, imposes itself and dominates by means of codes. The author makes some notes about this freedom provided by general gymnastics, adding that it can be used by the use of devices, the attire used, the number of participants and the musical sense. Nunomura and Tsukamoto 2009 apud Araujo and Guzzoni (2016) assure that the authors are differentiated by their positions, because there are those who consider general gymnastics as a modality, there are those who consider it as a manifestation of body culture, and there are those who consider it an activity.

The Brazilian Gymnastics Confederation, clarifies that gymnastics can be divided into six modalities of which are: artistic gymnastics, rhythmic gymnastics, acrobatic gymnastics, aerobic gymnastics, gymnastics for all and acrobatic trampoline (GINASTICS, 2018).

Souza (1996, p.01) states that: “we can infer that all manifestations related to Gymnastics, Dance and Games, which do not have competitive purposes, are considered General Gymnastics”.

Gymnastics is a method of expression of body study divided into five areas: competition, presentation, fitness, body awareness and rehabilitation (LIMA et al 2015). Clarifies Araujo and Guzzoni (2016) that the International Gymnastics Federation (FIG) that gymnastics is considered an “activity”, can even be seen as dance and or as games, allowing it to be competitive or not. In the same sense, says Ayoub:

[...] comprises the sphere of leisure-oriented gymnastics and includes programs of activities in the field of gymnastics (with or without devices), dance and games, according to national and cultural preferences. Events and competitions can also be part of the GG [...] it is primarily an activity within a context of enthusiasm and play, and participation is, above all, determined by the pleasure of practicing (AYOUB, 2003, p. 46-47).

According to Stanquevisch (2004), General Gymnastics (GG) can be taken “as a body demonstration, which allows interested people to participate in this activity, which does not depend on age, category or physical aspect. In addition, General Gymnastics has the important purpose of enabling socialization, as

well as improving the quality”.

## **5. Gymnastics at school**

The gymnastics at the school within Brazil began together with the first Brazilian Physical Education school, which originated on March 3, 1910 and was taught by the commander and director Captain Delphin Balancior of the French Military Mission (RAMOS, 2008).

According to Ayoub, 2013 apud Sargi et al, 2016, the contributions of general gymnastics to the means of training in Physical Education, is an efficient activity that meets the human depth which provides the recomposition of Gymnastics as a body activity. Barbosa-Rinaldi and Paoliello (2008) apud Sargi et al (2016) also add that the work with Gymnastics is a space for intervention by professionals in the area and, therefore, point out that it is necessary for them to want to work with gymnastics to be adequately trained. Costa (2016) points out that the understanding that gymnastics is a modality that only covers issues related to high performance needs to be suppressed, introducing gymnastics that enables health promotion, physical and mental well being, social interaction, among other benefits, being necessary content in school Physical Education classes, and should even be added as content in the annual planning. The authors Schiavon and Nista-Piccolo point out the applicability of gymnastics by teachers:

The lack of knowledge on how to apply Gymnastics, by teachers, is the main reason presented, showing that these professionals have difficulties in visualizing this sport beyond their competitive perspective. That is, they don't know what the contributions of learning this sport are to the motor development of their students. This issue may suggest the existence of failures in the training of Physical Education professionals, related to the knowledge of Gymnastics as a cultural phenomenon that is not limited to the competitive aspect (SCHIAVON; NISTA-PICCOLO, 2007, p. 132).

General gymnastics is an essential subject in schools, but it has not been much taught by the lack of experience of teachers, because they prefer more esteemed sports. Even though it is widespread in schools and physical education classes, gymnastics is still poorly represented as a result of some issues, such as poor understanding or comprehension, precarious resources, such as lack of materials, or even wrong teaching methods (AYOUB, 2007, apud LIMA et al, 2015). Nora, Taugen and Paim (2018), affirm that currently the gymnastics within the School Physical Education, has not been performed adequately. Many aspects contribute to this fact, such as the lack of preparation of gym teachers in the school environment, and their lack of understanding of the benefits it can provide to students. Within this context, they emphasize the importance of gymnastics at school: “The presence of Gymnastics in the school environment is important, because it stimulates reflection and helps the integration of students” (NORA, TAUGEN E PAIM, 2018, p.2).

## **6. Gymnastics in life**

The performance of gymnastics helps in several characteristics for the individual, especially in the complete development of the student, with regard to physical, psychological, intellectual and social aspects. General



Gymnastics aims to generate leisure, integration between people, awakening joy, moving to provide pleasure, physical and mental well-being at the same time (RAMOS, 2008).

Some authors corroborate the conception that general gymnastics provides numerous benefits such as the plurality of cultures of dances, folklore, and games, access to different types of materials, and the opportunity for everyone to participate, each one with his or her own creativity, which provides social coexistence, friendship, and respect (AYOUB 2004, TOLEDO 2001, BERTOLINI 2005, SANTOS 2001 apud RAMOS, 2008).

Souza (1997) apud Ramos, 2008, indicates other benefits brought by the practice of gymnastics, such as discipline, coordination, safety and control.

The authors Nora, Taugen and Paim (2018) bring the explicit positioning of the benefits brought by the practice of gymnastics. They affirm as benefits, the social interaction, the assistance in various developments such as physical, mental and cognitive. In addition, they add the improvement in the quality of life, and the interaction of the students themselves, without differences or discrimination.

Regarding general gymnastics, Menegaldo (2017) states that at the same time preserving the identity of gymnastics, values and abilities are added.

Ayoub (2003) apud Torres (2011) makes it clear that General Gymnastics can offer not only the fun and enthusiasm that the activity itself produces, but also awakens creativity, promotes playfulness and diverse interpretations of gymnastics, seeking new contents and possibilities of gymnastic expression.

## **7. Final considerations**

According to the position of the authors researched through the methodology already presented, gymnastics has not been taught in an adequate way due to several aspects, among them, the lack of preparation of teachers and their misunderstanding of the benefits it can provide to the student, and gymnastics is still poorly represented due to little understanding or comprehension, precarious resources, such as the lack of materials, or even wrong teaching methods. General gymnastics provides numerous benefits such as the opportunity for everyone to participate, as well as discipline, coordination, safety and mastery. In addition, it improves the quality of life, and the interaction of the students themselves, without differences or discrimination.

## **8. Competing Interests**

The authors declare no competing interests.

## **9. References**

ARAUJO, Angeliza Segov; GUZZONI, Cristiana Vianna. General Gymnastics. São Paulo: Editora Sol, 2016. Available at: <https://www.passeidireto.com/arquivo/35387665/ginastica-geral>>. Access on: 22 Nov, 2011.

AYOUB, E. General Gymnastics and School Physical Education. Campinas: Publisher of Unicamp, 2003.

Available at: <https://www.skoob.com.br/ginastica-geral-e-educacao-fisica-escolar-377951ed427005.html>>  
Accessed on: 20 Nov. 2018.

CAETANO, Ana Patricia Freires et al. Experiencing gymnastics: analyzing the gymnastic preferences in the general gymnastics discipline of the physical education course of the Federal University of Ceará. *Conexões*, v. 13, n. Esp., p. 197-210, 2015.

GIL, Antonio Carlos. Research projects. São Paulo, Atlas, 1991.

COSTA, Andrize Ramires et al. Gymnastics at school: where is she teaching? *Connections*, v. 14, n. 4, p. 76-96, 2016.

GYNAMICS, Brazilian Gymnastics Confederation. Modalities. Available at: <http://www.cbginastica.com.br/>> Access at: 22 Nov. 2018.

GUIOTTE, Vinícius Albuquerque et al. Avaliação Físico-Funcional de Athletes da Ginástica Rítmica: Histórico de Lesões e Estabilidade Postural. *Journal of Health Sciences*, v. 14, n. 4, 2015.

LIMA, Leticia Bartholomeu de Queiroz et al. General gymnastics in elementary school in the city of Rio Claro/SP: the perspective of students. *Conexões*, v. 13, n. Esp., p. 27-38, 2015.

MARQUES, Heitor Romero et al. Methodology of research and scientific work. Campo Grande, UCDB, 2017.

MENEGALDO, Fernanda Raffi; BORTOLETO, Marco Antonio Coelho. The teaching of rhythmic gymnastics: in search of new pedagogical strategies. *Motrivivência*, v. 29, n. 52, p. 305-318, 2017.

NORA, Luana França Dara; TAUGEN, Amanda Diangelis Marques; PAIM, Maria Cristina Chimelo. THE IMPORTANCE OF GYMNASTICS IN SCHOOL PHYSICAL EDUCATION CLASSES, IN THE TEACHERS' VIEW. *Proceedings of the International Seminar on Education-SIEDUCA*, v. 1, n. 1, 2018.

RAMOS, Eloiza da Silva Honório et al. The importance of general gymnastics at school and its benefits for children and adolescents. *Revista Movimento e Percepção*, v. 9, n. 13, p. 190-199, 2008.

SARGI, Andrey Amorim et al. Gymnastics for all in professional training in Physical Education: Contributions from the university extension. *Corpoconsciência magazine*, v. 19, n. 3, p. 11-21, 2016.

SCHIAVON, Laurita; NISTA-PICCOLO, Vilma L. The gym goes to school. *Movement*, v. 13, n. 3, 2007.

SOUZA, Elizabeth Paoliello Machado de; GALLARDO, Jorge Sérgio Pérez. General Gymnastics: two visions of a phenomenon. *Collection: texts and summaries of the I and II General Gymnastics Meeting*.

Campinas, SP, 1996. Available at: <http://www.ucdb.br/docentes/main1.php?menu=arquivos2&pasta=23411>>. Access in 24 Nov. 2018.

STANQUEVISCH, Q. Possibilities of the body in general gymnastics from the speech of those involved. 2004. 106 f. Dissertation (Masters in Physical Education) - Faculty of Health Sciences, Methodist University of Piracicaba, 2004. Available at: [http://www.ginasticas.com/conteudo/gimnica/gin\\_geral/ginasticas\\_com\\_gimnica\\_possibilidadesdocorponagg.pdf](http://www.ginasticas.com/conteudo/gimnica/gin_geral/ginasticas_com_gimnica_possibilidadesdocorponagg.pdf)>. Access at: 23 Nov. 2018.

TORRES, Thatiana; CORREA, Cláudia Xavier. The general gymnastics in the constructivist perspectives critical overcoming: possibilities of application in school physical education. Granbery Methodist College Magazine. Available at: <http://re.granbery.edu.br>, n. 10, 2011.

WERNER, Peter H; WILLIAMS, Lori H.; HALL, Tina J. Teaching Gymnastics to Children. Translated by Lúcia Helena Seixas Brito. 3 Ed. Manole: 2015.

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>).

# **Mental health and workers in the context of the COVID-19 pandemic: an international literature Survey**

**Pedro Henrique Conte Gil**

Universidade Federal do Rio Grande do Sul – UFRGS

<https://orcid.org/0000-0003-1158-8199>

**Marta Elisete Ventura da Motta**

Universidade de Caxias do Sul – UCS

<http://orcid.org/0000-0001-5551-2343>

**Maria Emília Camargo**

Universidade de Caxias do Sul – UCS

<https://orcid.org/0000-0002-3800-2832>

**Lisarb do Amaral Ribeiro**

Centro Universitário da Serra Gaúcha – FSG

<https://orcid.org/0000-0003-0801-4098>

**Tiane Camargo**

Universidade Franciscana – UFN

<https://orcid.org/0000-0003-2423-3928>

## **Abstract**

*In March 2020, the World Health Organization (WHO) declared that Covid-19 reached the pandemic level. In this regard, quarantine measures were applied by governmental organizations. Such measures had a negative impact on the mental health of the whole population, and thus, of the workers. This study aims to survey the international literature on aspects of mental health in workers in the context of the Covid-19 pandemic, available in the Scopus database. The methodology used is classified as exploratory, descriptive, and quantitative with a bibliometric approach. After searching and applying inclusion and exclusion criteria, a total of 217 documents were retrieved. For analysis, 7 thematic axes were organized, pointing out the main findings of each topic. As results, it was found that there is an important academic production on mental health aspects of health professionals, and less investigations with workers from other contexts. Still, it was identified that Brazilian researchers have played an important role in the production of this knowledge. It is concluded that the entire scientific community is engaged, especially in the health field, to conduct investigations addressing aspects of mental health and workers in the context of the Covid-19 pandemic.*

**Keywords:** Mental health; workers; pandemic; Covid-19; Survey.

## 1. INTRODUCTION

The World Health Organization (WHO) declared, in March 2020, that Covid-19, caused by the new coronavirus (Severe Acute Respiratory Syndrome Coronavirus 2 - Sars-Cov-2), achieved the pandemic level (Fiocruz, 2020). According to the Organization, pandemics are outbreaks of new diseases that reach spread on a global scale, a higher level than the well-known epidemics, which affect a specific region and make a small amount of the population sick.

The first case of Covid-19 infection was reported in China in early December 2019 (Xiao, 2020). In Brazil, the first case was notified about three months later, on February 25, 2020 (Brazil, 2020). By the timing of finishing this article, on December 2, 2020, 64,367,697 confirmed cases and 1,489,897 deaths have been documented worldwide (WHO, 2020). On that same date, Brazil had 6,436,650 confirmed cases and 174,531 deaths (Brazil, 2020).

It is known that pandemics, in general, have social implications from the micro to the macro-systemic level, imposing, during the time that they last, new organizations, habits and mobilizations of different orders to contain their spread (Morens, Folkers, & Fauci, 2009). In this context of social aspects, the Ministry of Health (Brazil, 2020) broadcasted several recommendations to the population to alert them about transmission, prevention, and procedures in case of contagion due to the disease. Thus, the main proposal for coping with the spread of the virus was social distance, with the population being instructed to stay at their homes and leave them only in cases of need (such as, for example, going to the market, pharmacy, health care, and urgencies).

Due to their polysemy and, sometimes, the arbitrariness of their use, it is important to differentiate the concepts of social distance, social isolation, and quarantine in the context of a pandemic. According to Wilder-Smith and Freedman (2019), social distance is the idea of mitigating contacts and physical approximations between individuals of a population, in order to diminish the speed of contagion; isolation refers to a way of separating people already infected with the virus from those who are not infected or are asymptomatic; and, finally, quarantine as a way to decrease the circulation of people who have potentially been exposed to the disease. In order to delay and insure the peak incidence and the number of deaths from the pandemic, many countries have adopted containment measures, such as the isolation of suspected cases, the closure of educational institutions, the social distance of people considered to be at-risk groups, as well as quarantine of the entire population (Brooks et al., 2020, Ferguson et al., 2020).

These containment measures have implied in negative factors to the population, such as risks to the mental health. In this moment, it turns to be important to highlight that mental health is a broad concept and difficult to be defined, such as its determinants (Alves & Rodrigues, 2010). In the same way that health is not just about the absence of disease, mental health is not restricted to the absence of mental disorders or

syndromes (Scliar, 2007). For this reason, mental health has been understood as a product of multiple and complex interactions, which involves biological, psychological, and social factors. Furthermore, it is expressed and evaluated through different constructs in the literature, such as aspects that denote favorable conditions (e.g. well-being, quality of life, resilience, etc.) and adverse conditions (e.g. anxiety, depression, post-traumatic stress, etc.)(Alves & Rodrigues, 2010).

In the relationship between mental health and isolation, the literature review by Brooks et al. (2020) identified that the negative effects of quarantine include symptoms of post-traumatic stress, confusion, and anger. Other study has identified that the fear of being infected with a virus of rapid and wide-spread, potentially fatal, ends up affecting the psychological well-being of many people (Asmundson & Taylor, 2020; Carvalho et al., 2020). Nevertheless, symptoms of depression, anxiety and stress are perceived in the general population (Wang et al., 2020) and, specifically, in health professionals (Zhang et al., 2020).

Regarding to the workers' mental health, specifically in the context of the Covid-19 pandemic, it was found that health professionals, who work as frontiers in dealing with the new coronavirus, have been significantly affected (Teixeira et al., 2020). In addition to the risk of contamination, which put them away from work, the close relationship with illness and death has resulted in intense psychological distress. These, most of times, is manifested in generalized anxiety disorders, sleep disorders, fear of getting ill and contaminating colleagues and family members.

Although, it is perceived that not only health professionals have experienced negative effects, resulting from the pandemic situation, but also workers in general (Shojaei & Masoumi, 2020). Concerns about financial difficulties and the possible lack of basic supplies, have caused damage to the psychological well-being of these population.

In this sense, there are scientific productions available which involves: drivers of private transport applications (Uchôa-de-Oliveira, 2020), deliverers by application (Manzano & Klein, 2020), domestic workers (Pinheiro, Tokarski, & Vasconcelos, 2020), workers who maintained their activities in the pandemic period (Modesto, de Souza, & Rodrigues, 2020), workers unable to do their work at a distance, or in an informal situation (Barbosa, Costa, & Hecksher, 2020), university professors (da Silva, Estrela, Lima, & Abreu, 2020) and also workers in general in a home-office situation, who started to exercise their functions remotely (Lizote, Teston, Martendal, Tobias, & Assi, 2020). Most of these findings converge to the same results, pointing out negative impacts on aspects associated with the workers' mental health. Even though these effects are often attributed to a certain plurality of secondary reasons, invariably, they are all associated with the Covid-19 pandemic context.

It is important to point out that there is significant range of scientific production in worldwide literature about the Covid-19 pandemic. The main reason for this consists on a significant number of institutions, universities, research groups and researchers from all over the world, have abdicated their private interests and turned their attention to the new demands generated by the current context. In quantitative terms, until



October 2020, about 168,546 publications on the pandemic were registered. Of these, 4,029 were produced in Brazil, being the country that ranks the 11th place among those that produced the most scientific articles on the current pandemic situation (GLOBO, 2020).

Therefore, given the extensive production of publications on the Covid-19 pandemic, a material that can map studies that investigate the different impacts of the pandemic on the population's health becomes deeply relevant. The present study proposes to meet this demand, aiming to carry out a survey of the international literature on aspects of mental health in workers in the context of the Covid-19 pandemic, available in the Scopus database.

## **2. METHOD**

The present study has an exploratory, descriptive, and quantitative design (Ciervo, Bervian, & Silva, 2007) with a bibliometric approach (Hayashi, 2012). Research with this methodological design makes it possible to map the available scientific literature of a certain area of knowledge (Silva, Hayashi, & Hayashi, 2011). Through the construction of bibliometric indicators, the results make it possible to analyze academic productions by different authors, institutions, and regions in the world.

As a procedure, the search for documents was conducted in the Scopus database. This source was chosen because it is one of the main repositories of publications that index scientific journals from different areas of knowledge. Specially for this work, indexes which investigate aspects of the worker's mental health and their relationship with the current Covid-19 pandemic context.

Regarding the period, the time frame of this study is based on the WHO declaration, when the Organization characterized Covid-19 as a pandemic level (March, 2020), a measure that is closely associated with the beginning of social distancing measures (quarantine) worldwide (WHO, 2020). In this way, the search was restricted to the year 2020, until November 28, 2020, date of the recovery of the documents from the database. The descriptors used were: "mental health" AND "workers" AND "covid-19".

Documents identified in this search were categorized with the support of the Rayyan software. At first, the year of publication (2020) and open-access materials were considered as inclusion criteria.

Then, after reading the title, articles that did not involve the following criteria, were excluded:

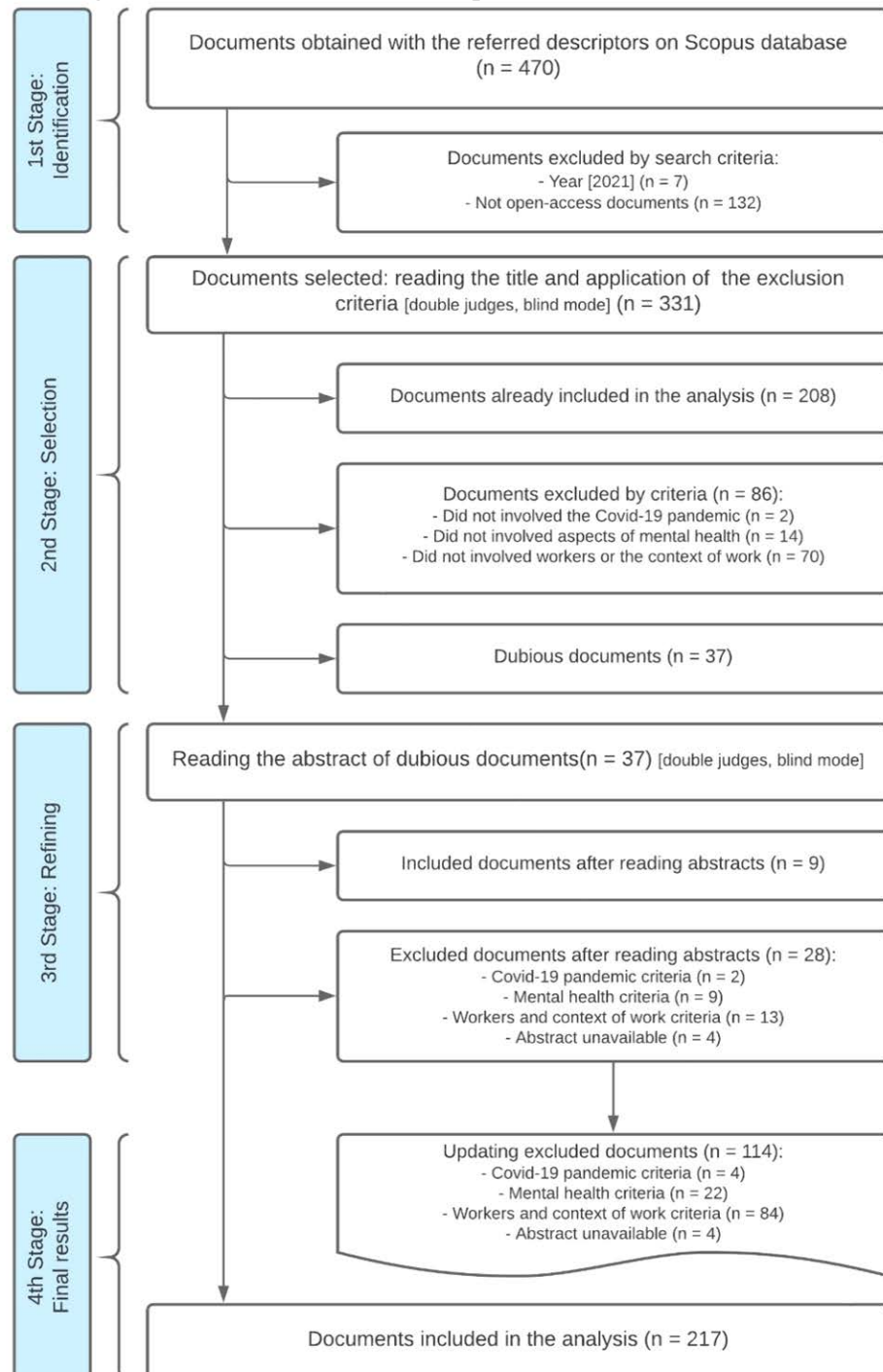
- (1) the Covid-19 pandemic
- (2) aspects related to mental health and
- (3) workers in the context of their work.

Those that remained dubious for the evaluators, the abstract was read for verification. After this, according to the criteria above, the document was included or excluded from the final sample. The remaining articles of this process comprised the analysis of this article. The details of this selection process are shown in the

flowchart below (Figure 1).

All inclusions and exclusions from the documents involved at least two judges, authors of the article, simultaneously and independently. In situations of disagreement, a third judge (also author) was consulted for decision making.

**Figure 1 – Flowchart of the search process and selection of articles**



Source: elaborated by the authors

### **3. ANALYSIS AND DISCUSSION OF RESULTS**

The results of the present article, a survey of the international literature on aspects of mental health and workers in the context of the Covid-19 pandemic, will be presented in 7 axes. These are (1) Access type and year; (2) Publication stage and document type; (3) Language and Country/Territory; (4) Authors and most cited publications; (5) Main journals, study area and institutions; (6) Main worker-participants and (7) Main aspects of Mental Health.

In addition to the results data being presented descriptively, discussions on the findings are proposed, with special attention to materials published in Brazil or by Brazilian researchers.

#### ***3.1 Access type and year***

In the first stage of the search, the descriptors “mental health” AND “workers” AND “covid-19” were used in the SCOPUS database. Thus, a total of 470 records was obtained, without the application of any filter for refinement. Of these, 331 (70.4%) were open access, while the remainder ( $n = 139$ , 29.6%) were restricted access. In this sense, it is questioned that, even though the Covid-19 pandemic is considered one of the greatest humanitarian crises in the history of the world, having impacted and mobilized all spheres of societies, almost a third of the knowledge produced about it is freely inaccessible to the population. In the face of so many misunderstood and false information regarding the pandemic (Duarte, 2020), it is important to disseminate and propagate committed and consistent science in order to mitigate misinformation and enable coping strategies, a condition that is directly or indirectly facilitated by free access documents.

Also related to the first stage of the search, without the application of the year filter (2020) to restrict the materials, it was found that 463 records (98.5%) were from 2020. However, the search had a projection of studies to be made available in 2021 ( $n = 7$  articles, 1.5% of documents). Undoubtedly, it was expected that most documents on the subject would be in 2020 year, since most research institutions interrupted their ongoing investigations to address current demands of the pandemic (WHO, 2020).

The analysis of the following axes will be based on the result of documents found after the application of all inclusion and exclusion criteria, 217 materials.

#### ***3.2 Publication stage and document type***

Within the documents selected for the final analysis ( $n = 217$ , 46.1% of the first stage records), it was observed that of these, 171 (78.8%) were in the final stage of publication and the remaining ( $n = 46$ , 1.2%) in in-press mode. As for the type of document, 154 (71%) were articles, 26 (12%) literature reviews, 16 (7.3%) letters, 10 (4.6%) notes, 8 (3.7%) editorials, 2 (0.9%) data paper and 1 (0.5%) conference paper. Bearing in mind that the mental health of workers in the Covid-19 pandemic is a recent and emerging issue, which robust evidence on its numerous implications is still needed, it was decided to include records that

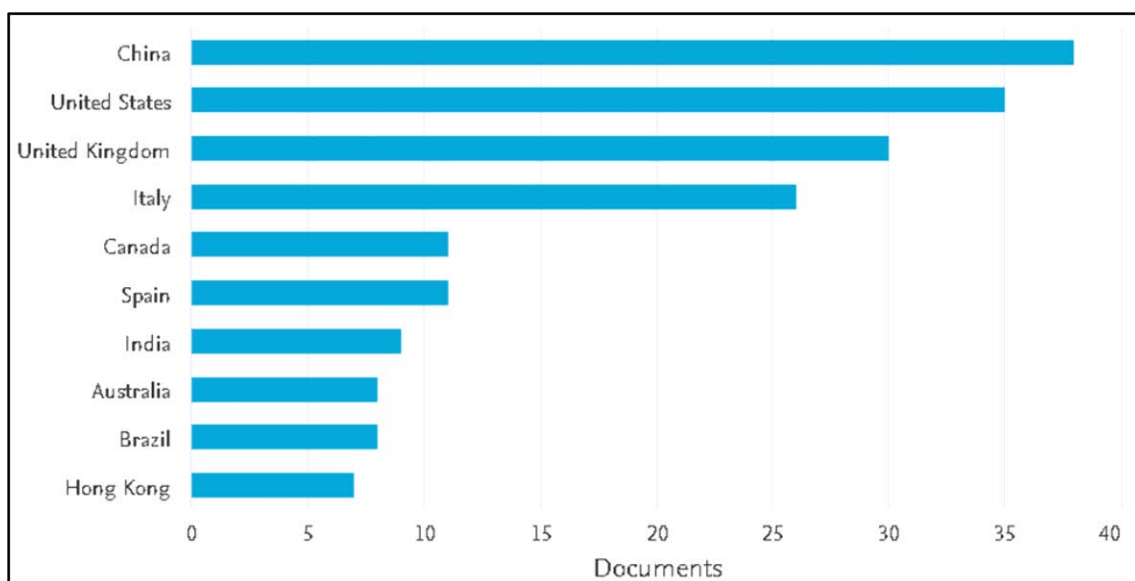
were not articles. This decision included documents from different sources, providing a more comprehensive mapping of publications on the subject.

### 3.3 Language and Country/Territory

Most of the documents were published in English ( $n = 212$ , 95.92%), followed by Portuguese ( $n = 3$ , 1.35%) and Spanish ( $n = 3$ , 1.35%), German ( $n = 2$ , 0.90%) and Russian ( $n = 1$ , 0.45%). However, in this sense, 221 records (1.84% more) are counted, which indicates there are documents which had publications in more than one language.

Regarding the origin of the publication of the materials, a certain diversity of countries or territories is identified. In this sense, China leads with the largest number of publications ( $n = 38$ , 17.51%), followed by the United States ( $n = 35$ , 16.12%) and the United Kingdom ( $n = 30$ , 13.82%). Brazil is on the list of the ten countries that most produced materials about this survey study, with 8 documents published (3.86%). Check below (Figure 2) better details on these ten countries with the largest number of publications.

**Figure 2 – Documents by country or territory**



Source: Scopus results (2020)

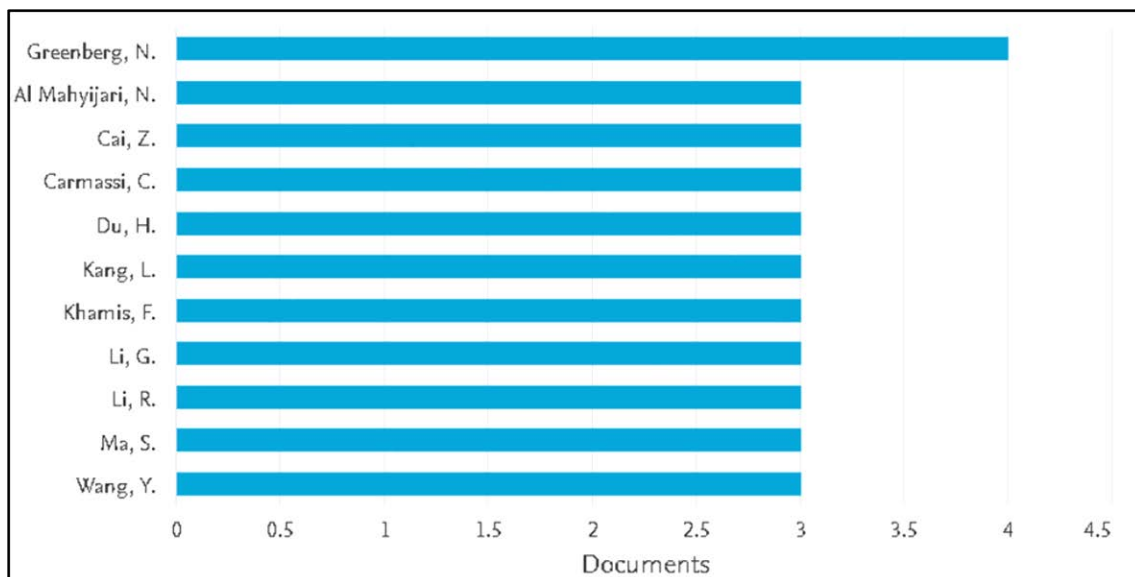
### 3.4 Authors and most cited publications

Greenberg was the author who most published materials on aspects of mental health and workers in the context of a pandemic, available from Scopus. Beyond that, Greenberg is the only one with 4 (1.84%) publications of the total documents of the present survey, considering all of them investigates aspects of health professional's mental health. Among its materials, the most cited article was "Managing mental health challenges faced by healthcare workers during covid-19 pandemic" (Greenberg, Docherty, Gannapragasam, & Wesseley, 2020), accounting 243 quotes.

Regarding to the other authors ( $n = 159$ ), 10 (6.28%) of them had 3 publications, 38 (23.9%) had 2, and the

others 111 (69.82%) had 1 publication. Below (Figure 3), the authors who published between 4 and 3 materials about the study's theme are presented.

**Figure 3 – Documents by author**



Source: Scopus results (2020)

In the context of citations, there were differences in the number of citations between the first ten studies. The first place (Lai et al., 2020) accounts 781 citations, while the tenth (Williamson, Murphy, & Greenberg, 2020) 31. The ten publications with most citations are described below (Table 1). The Brazilian documents, although not being inside this range, involved 58 different authors and co-authors.

**Table 1 – Documents and citations**

Position	Document	Citations
1	Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019 (Lai, Ma, Wang, (...), Hu, 2020.)	781
2	Managing mental health challenges faced by healthcare workers during covid-19 pandemic (Greenberg, Gnanapragasam, & Wessly, 2020)	243
3	Mental Health and Psychosocial Problems of Medical Health Workers during the COVID-19 Epidemic in China (Zhang,, Wang, , Yin, , (...), Wang,, 2020)	108
4	Survey of Insomnia and Related Social Psychological Factors Among Medical Staff Involved in the 2019 Novel Coronavirus Disease Outbreak (Zhang,, Yang, Liu, (...), Zhang, 2020)	73
5	Mental Health Outcomes Among Frontline and Second-Line Health Care Workers During the Coronavirus Disease 2019 (COVID-19) Pandemic in Italy (Rossi, Socci, Pacitti, (...), Rossi, 2020)	53

6	COVID-19 Pandemic: Stress Experience of Healthcare Workers: A Short Current Review (Bohlken, Schömig, Lemke, (...), Riedel-Heller, 2020)	43
7	Dealing with psychological distress by healthcare professionals during the COVID-19 pandemia (Petzold, Plag, Ströhle, 2020)	41
8	Mitigating the psychological impact of covid-19 on healthcare workers: A digital learning package (Blake, Bermingham, Johnson, Tabner, 2020)	34
9	The COVID-19 pandemic: Major risks to healthcare and other workers on the front line (Sim, 2020)	33
10	COVID-19 and experiences of moral injury in frontline key workers (Williamson, Murphy, Greenberg, 2020)	31

Source: elaborated by the authors, based on Scopus results (2020)

### 3.5 Main periodicals, field of study and institutions

The documents identified in the database search, are published in several journals (n = 127 in total). The International Journal of Environmental Research and Public Health occupies the first position in quantity of publications (n = 30, 18.86%), followed by the Psychological Trauma Theory Reserach Practice and Policy with 8 (3.68%) publications. The third place is disputed among 3 other journals, with 7 (3.22%) publications each.

Table 2 shows the journals with the most documents published (n = 12, 9.44%), considering the ones which had at least 3 materials referred in each. Journals that presented only 1 or 2 records (90.56%) were not included.

**Table 2 – Journals with more publications**

Position	Journal	Materials
1	International Journal of Environmental Research and Public Health	30
2	Psychological Trauma Theory Research Practice and Policy	8
3	Frontiers in Psychiatry	7
3	Frontiers in Psychology	7
3	International Journal of Social Psychiatry	7
6	Plos One	5
7	Globalization and Health	4
7	Indian Journal of Psychiatry	4
9	Asian Journal of Psychiatry	3
9	Disaster Medicine and Public Health Preparedness	3
9	Journal of Medical Internet Research	3
9	Sustainability Switzerland	3

Source: elaborated by the authors, based on Scopus results (2020)

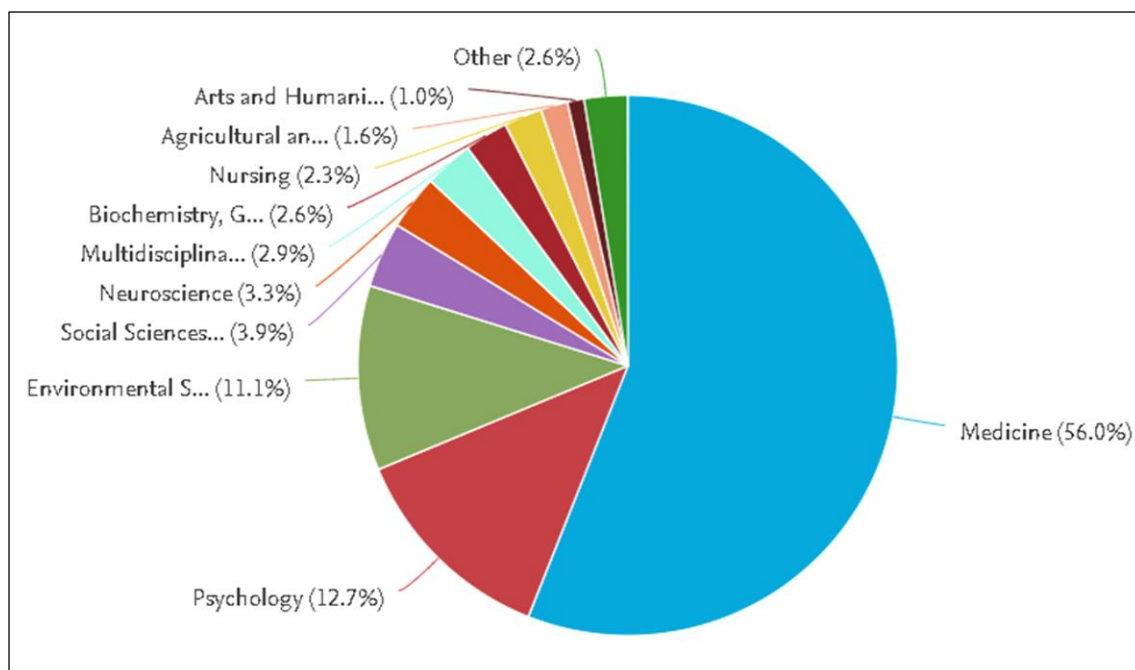


Considering the eight documents produced by Brazilian researchers, they are linked to eight different journals. These journals are: Science and Collective Health, Clinics, International Journal of Environmental Research and Public Health, Journal of Medical Internet Research, *Revista Brasileira de Enfermagem*, *Revista da Sociedade Brasileira de Medicina Tropical*, *Revista Enfermagem* and *Revista Latino Americana de Enfermagem*.

Regarding the study area, the predominance was upon Medicine (56%), followed by Psychology (12.7%) and Environmental Sciences (11.1%). Such data seems to reinforce that the health field is the one that is most concerned with producing knowledge in relation to mental health, which, in fact, are the fields that are concerned with investigating it directly.

However, it is necessary to consider mental health as a phenomenon in an interdisciplinary dimension, proposing intersections between different fields of knowledge, such as Social Sciences. This objective could promote advances in biomedical conceptions, dichotomized and separation between the emotional and physical aspects of mental health (Scliar, 2007).

**Figure 4 – Documents by subject**



Source: Scopus results (2020)

The institutions which presented the most quantity of publications were: Tongji Medical College, King's College London, Huazhong University of Science and Technology, with six published documents (2.8% each), followed by the University of Toronto and Renmin Hospital of Wuhan University with five published documents (2.3% each), Chinese University of Hong Kong and Monash University with four documents (1.84% each) and Southern Medical University, Harvard Medical School and Hong Kong Polytechnic University with three documents (1.38% each).

In relation to Brazil, 14 different institutions were identified, with 1 document published by each. The institutions were: Federal University of Rio de Janeiro, Federal Fluminense University, Paulista State University, Federal University of Rio Grande do Sul, University of São Paulo, Federal University of Bahia, Hospital de Clínicas from Porto Alegre, Federal University of Santa Catarina, University of Passo Fundo, Oswaldo Cruz Foundation, Federal University of Goiás, State University of Maringa, State University of Campinas, Health Institute of São Paulo.

### **3.6 Main participants-workers**

Due to the complexity of this section, it was decided to organize the records according to the different study work-participants accessed by the publications. Therefore, it is proposed to divide the materials into four distinct groups, which are:

(a) Health Professionals (HP) (n = 137 documents, 64% of the sample); (b) Specified HP (n = 42, 19%); (c) Comparisons between HP and others (n = 9, 4%) and (d) Other workers (n = 29, 13%).

The composition of the groups is detailed below, accordingly to the equality or similarity of participants-workers of the studies:

(a) Health Professionals (HP): unspecified HP (n = 118, 86.1%), HP front-line (n = 13, 9.5%) and HP front-line and secondary line (n = 6, 4.4%).

(b) HP Specialist: doctors (n = 10, 23.8%), residents of many specialties (n = 7, 16.6%), nurses (n = 6, 14.3%) and other 10 HP specialist categories (representing n = 19, 45.3%).

(c) Comparisons between HP and others: HP and other workers (n = 6, 66.67%), HP and patients (n = 2, 22.22%) and HP, patients, and others (n = 1, 11.11%).

(d) Other workers: general workers (n = 9, 31%), migrant workers (n = 4, 13.8%), military workers (n = 3, 10.3%) and other 11 workers' categories (representing n = 13, 44.9%).

Regarding specifically to the 8 Brazilian published documents, it was identified that 6 (75%) involved general health professionals, 1 (12.5%) frontline professionals and 1 (12.5%) general workers (non-health professionals).

Considering that groups (a), (b) and (c), involve mainly HPs, it is observed that most studies (n = 188, 86.63%) aimed to investigate aspects of the mental health of the working population from the health field. There is a high relevance in investigating such population, since they face very high risks of exposure to Covid-19 and, consequently, suffer from the inherent impacts on their mental health. However, it is known that the pandemic invariably had repercussions on all other workers and work contexts (Duarte et al., 2020). In this sense, pointing out the disparity in the production of knowledge about other workers, it is clear the relevance of conducting investigations regarding mental health aspects on workers outside the health context.

### **3.7 Main aspects of Mental Health**

In the same sense as the previous axis, there is an expressive construct related to mental health. Thus, it is suggested following agglutination of elements, based on an analysis that constitutes 5 different groups:

(a) Mental Health (MH) and its general aspects (n = 156 documents, 72% of the sample); (b) Stress (n = 31, 14%); (c) Anxiety or Depression (n = 17, 8%); (d) Well-being (n = 8, 4%) and (e) Resilience (n = 5, 2%).

Again, the composition of the groups is detailed below, accordingly to the equality or similarity of the MH aspects assessed by the studies:

(a) Mental Health (MH) and its general aspects: MH general aspects (n = 89, 57%), MH and Psychological Impacts (n = 34, 21.8%), MH and Psychosocial factors (n = 9, 5.8%), MH and Psychological interventions (n = 9, 5.8%) and 5 other categories (n = 15, 9.6%).

(b) Stress: General stress (n = 15, 48.4%), Post-traumatic stress (n = 8, 25.8%), Stress and Burnout (n = 5, 16.1%) and 2 other categories (n = 3, 9.7%).

(c) Anxiety or Depression: Anxiety/Depression (n = 10, 58.9%), Anxiety (n = 5, 29.4%) and Depression (n = 2, 11.7%).

(d) Well-being and (e) Resilience were aspects that did not vary, each one being a distinct and specific group.

Regarding specially about the 8 studies conducted in Brazil, it was perceived that most documents involved general aspects of mental health (n = 4, 50%) and the rest concentrated on investigating depression, anxiety and lifestyle (n = 1, 12.5%), stress (n = 1, 12.5%), psychological interventions for HP (n = 1, 12.5%) and well-being (n = 1, 12.5%).

Based on groups (a), (b) and (c), most of documents (n = 204, 94%) are related to investigate aspects perceived as adverse in the workers mental health, in the context of the Covid-19 pandemic. Aspects favorable to mental health, represented by groups (d) and (e), had fewer records. These results demonstrate that research has been concerned with further investigating the damage caused by the pandemic, which is essential. However, it is pointed out that it is also important to produce more publications about favorable conditions, such as positive aspects of mental health. In this sense, conducting studies that address the possibilities of coping, through psychological interventions, can propose alternatives to mitigate the impacts of the pandemic caused to the mental health of workers in the most varied contexts.

## **5. FINAL CONSIDERATIONS**

Taking into perspective the several publications about the Covid-19 pandemic, this article proposed to carry out a survey of the international literature regarding to aspects of mental health in workers in the current context, available in the Scopus database. From the application of the inclusion and exclusion criteria, a

total of 217 records were obtained. The main limitation of the study is the use of only one database, Scopus, for the survey of documents. For this reason, it is suggested that further surveys be conducted, covering different international databases.

The results were organized and presented in seven axes: (1) Access type and year; (2) Publication stage and document type; (3) Language and Country/Territory; (4) Authors and most cited publications; (5) Main journals, study area and institutions; (6) Main worker-participants and (7) Main aspects of Mental Health. In addition to the analysis of the results of each referred axis, with their respective percentages of the total quantity and of the main findings, a space was dedicated to the description and discussion of publications in Brazil or by Brazilian researchers.

In summary, the findings indicate that most articles were published in English; in China's territory; Greenberg was the researcher who most published materials; the study with the most citations was conducted by Lai et al. (2020); the International Journal of Environmental Research and Public Health was the journal that most published documents about the MH; records predominantly are from the field of Medicine and Psychology.

As for the workers, most were health professionals, without the studies inferring their specifications. In the context of mental health, likewise, most records did not specify which aspect of mental health they sought to investigate. For this reason, this study confirms that there is a concern and commitment to produce knowledge, mainly by the health field, about the mental health of workers in the context of Covid-19.

Finally, Brazil had 8 publications retrieved in the search for this study. In this sense, Brazilian studies appear in the indexes of several axes presented here, since the country is located within the ten territories with more productions on the subject. Thus, it can be inferred that there is an engagement of Brazilian researchers in corroborating with science.

## References

- [1] Alves, A. & Rodrigues, N. F. (2010). Determinantes sociais e económicos da Saúde Mental. *Revista Portuguesa de Saúde Pública*, 28(2), 127–131. doi: [https://doi.org/10.1016/S0870-9025\(10\)70003-1](https://doi.org/10.1016/S0870-9025(10)70003-1)
- [2] Asmundson, G. J. G., & Taylor, S. (2020). Coronaphobia: fear and the 2019-nCoV outbreak. *Journal of Anxiety Disorders*, 70, 102-196. <http://dx.doi.org/10.1016/j.janxdis.2020.102196>
- [3] Barbosa, A. L. N. H., Costa, J.S., & Hecksher, M. (2020). Mercado de trabalho: conjuntura e análise / Instituto de Pesquisa Econômica Aplicada; *Ministério do Trabalho*, 1, 0, (mar.1996). Brasília: Ipea. doi: <http://dx.doi.org/10.38116/bmt69>
- [4] Brasil. Ministério da Saúde. (2020). Centro de Operações de Emergências em Saúde Pública COE-COVID-19. Plano de contingência nacional para infecção humana pelo novo coronavírus COVID-19 [Internet]. *Brasília: Ministério da Saúde*; 202024 p. Available on: <https://portalarquivos2.saude.gov.br/images/pdf/2020/fevereiro/13/plano-contingencia-coronavirus-COVID19.pdf>

- [5] Brasil. Ministério da Saúde. (2020). Lei nº 13.979, de 6 de fevereiro de 2020. Dispõe sobre as medidas para enfrentamento da emergência de saúde pública de importância internacional decorrente do coronavírus responsável pelo surto de 2019. *Diário Oficial da União*. Brasília: Brasil. Available on: <https://www.in.gov.br/en/web/dou/-/lei-n-13.979-de-6-de-fevereiro-de-2020-242078735>.
- [6] Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet*, 395(10227), 912-920. [http://dx.doi.org/10.1016/S0140-6736\(20\)30460](http://dx.doi.org/10.1016/S0140-6736(20)30460)
- [7] Carvalho, P. M. M., Moreira, M. M., Oliveira, M. N. A., Landim, J. M. M., & Rolim Neto, M. L. (2020). The psychiatric impact of the novel coronavirus outbreak. *Psychiatry Research*, 286(112902), 1-2. <http://dx.doi.org/10.1016/j.psychres.2020.112902>
- [8] Cervo, A. L., Bervian, P. A., & Silva R. (2007). *Metodologia Científica*. São Paulo: Pearson Prentice Hall.
- [9] Duarte, M. Q., Santo, M. A. S., Lima, Ca. P., Giordani, J. P., & Trentini, C. M. (2020). COVID-19 e os impactos na saúde mental: uma amostra do Rio Grande do Sul, Brasil. *Ciência & Saúde Coletiva*, 25(9), 3401-3411. Epub August 28, 2020. doi: <https://dx.doi.org/10.1590/1413-81232020259.16472020>
- [10] Fiocruz (2020). Fundação Oswaldo Cruz. O que é pandemia e o que muda com a declaração da OMS. Available on: <https://www.arca.fiocruz.br/handle/icict/40500>
- [11] Hayashi, C. R. M. (2012). Apontamentos sobre a coleta de dados em estudos bibliométricos e cientométricos. *Fil. educ.*, 5(20), 89-102.
- [12] Lizote, S. A., Martendal, B. C., Tobias, J. C., & Assi, S.R. (2020). Bem-Estar Subjetivo e Home Office em Tempos de Pandemia: um Estudo com Discentes de Ciências Contábeis. *10º Congresso UFSC de Controladoria e Finanças*. Available on: <http://dvl.ccn.ufsc.br/10congresso/anais>
- [13] Manzano, M. & Krein, A. (2020). A pandemia e o trabalho de motoristas e de entregadores por aplicativos no Brasil. Campinas: Cesit/Unicamp. Available on: [http://www.cesit.net.br/wp-content/uploads/2020/07/MANZANO-M-KREIN-A.-2020\\_A-pandemia-e-os-motoristas-e-entregadores-por-aplicativo.pdf](http://www.cesit.net.br/wp-content/uploads/2020/07/MANZANO-M-KREIN-A.-2020_A-pandemia-e-os-motoristas-e-entregadores-por-aplicativo.pdf).
- [14] Morens, D. M., Folkers, G.K.; Fauci, A.S. (2009). What Is a Pandemic? *The Journal of Infectious Diseases*, 200(7), 1018–1021. doi: 10.1086 / 644537
- [15] Modesto, J. G., Souza, L. M., & Rodrigues, T. S. L. (2020) Esgotamento profissional em tempos de pandemia e suas repercussões para o trabalhador. *Pegada - A Revista da Geografia do Trabalho*, 21(2), 376-391. <https://doi.org/10.33026/peg.v21i2.7727>
- [16] OMS. Organização Mundial da Saúde. (2020) Organização Mundial da Saúde declara emergência de saúde pública de importância internacional em relação ao novo coronavírus. Available on [https://www.paho.org/bra/index.php?option=com\\_content&view=article&id=6100:oms](https://www.paho.org/bra/index.php?option=com_content&view=article&id=6100:oms)
- [17] Globo, O. (2020, novembro, 23). Brasil é o 11º país que produziu publicações científicas sobre Covid-19. [arquivo de vídeo]. Available on: <http://redglobo.globo.com/videos/v/brasil-e-o-11-pais-que-mais-produziu-publicacoes-cientificas-sobre-covid-19/9045377/>
- [18] Pinheiro, L., Tokarski, C. & Vasconcelos, M. (2020). Nota Técnica - 2020 - Junho - Número 75 – Disoc. *Vulnerabilidades das Trabalhadoras Domésticas no Contexto da Pandemia de Covid-19 No Brasil*. Available on: <https://www.ipea.gov.br/portal/index>
- [19] Scliar, M. (2007). História do conceito de saúde. *Physis: Revista de Saúde Coletiva*, 17(1), 29-41. doi: 10.1590/S0103-73312007000100003

- [20] Schmidt, B., Crepaldi, M. A., Bolze, S. D. A., Neiva-Silva, L., & Demenech, L. M. (2020). Impactos na Saúde Mental e Intervenções Psicológicas Diante da Pandemia do Novo Coronavírus (COVID-19). *Scielo Preprints*. Versão 1. doi:10.1590/SciELOPreprints.58
- [21] Shojaei, S. F., & Masoumi, R. (in press). The importance of mental health training for psychologists in COVID-19 outbreak. *Middle East Journal of Rehabilitation and Health Studies*. <https://doi.org/10.5812/mejrh.102846>
- [22] Silva, A. F., Estrela, F.M., Lima, N. S., & Abreu, C.T.A. (2020). Saúde mental de docentes universitários em tempos de pandemia. *Physis: Revista de Saúde Coletiva*, 30(2), e300216. Epub July 24, 2020. <https://doi.org/10.1590/s0103-73312020300216>
- [23] Silva, M. R., Hayashi, C. R. M., & Hayashi, M.C.P.I. (2011) Análise bibliométrica e cientométrica: desafios para aqueles que atuam no campo. *InCID: Revista Científica de Inf. e Doc.*, 2(1), 110-29.
- [24] Teixeira, Ca. F. de S., Soares, C. M., Souza, E. A., Lisboa, E. S., Pinto, I. C. M., Andrade, L. R., & Espiridião, M. A. (2020). A saúde dos profissionais de saúde no enfrentamento da pandemia de Covid-19. *Ciência & Saúde Coletiva*, 25(9), 3465-3474. Epub August 28, 2020. <https://doi.org/10.1590/1413-81232020259.19562020>
- [25] Uchôa-de-Oliveira, F. M. (2020). Saúde do trabalhador e o aprofundamento da uberização do trabalho em tempos de pandemia. *Revista Brasileira de Saúde Ocupacional*, 45(22). <https://doi.org/10.1590/2317-6369000012520>
- [26] Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in china. *International Journal of Environmental Research and Public Health*, 17(5), 1729. <https://doi.org/10.3390/ijerph17051729>
- [27] Wilder-Smith A., & Freedman, D.O. (2020). Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. *J. Travel. Med.*, 27(2) doi: 10.1093/jtm/taaa020.
- [28] WHO. World Health Organization. (2020). *Coronavirus disease (COVID-19) situation dashboard*. Geneva: Author. Available on: <https://covid19.who.int/>
- [29] Xiao, C. (2020). A novel approach of consultation on 2019 novel coronavirus (COVID-19)-related psychological and mental problems: Structured letter therapy. *Psychiatry Investigation*, 17(2), 175-176. <https://doi.org/10.30773/pi.2020.0047>
- [30] Zhang, C., Yang, L., Liu, S., Ma, S., Wang, Y., Cai, Z., ... & Zhang, B. (in press). Survey of insomnia and related social psychological factors among medical staffs involved with the 2019 novel coronavirus disease outbreak. *Frontiers in Psychiatry*. Available on: <https://www.frontiersin.org/articles/10.3389/fpsy.2020.00306>



## **Collective Experiences with Heritage: tourist events and socializations in the Historic Center of São Luís**

**PhD. Conceição de Maria Belfort de Carvalho**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.  
ORCID: <https://orcid.org/0000-0002-6234-527X>  
Email: [cbelfort@globocom](mailto:cbelfort@globocom)

**Msc. Donny Wallesson dos Santos**

Programa de Pós-Graduação em Políticas Públicas (PGPP),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.  
ORCID: <https://orcid.org/0000-0001-6556-4251>  
Email: [dws87@outlook.com](mailto:dws87@outlook.com)

**Msc. Maurício José Moraes Costa (Corresponding author)**

Centro Universitário UNDB  
São Luís, Maranhão, Brazil.  
ORCID: <https://orcid.org/0000-0002-0759-9285>  
Email: [mauriciojosemoraes@gmail.com](mailto:mauriciojosemoraes@gmail.com)

**PhD. Kláutenys Dellene Guedes Cutrim**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.  
ORCID: <https://orcid.org/0000-0002-8668-4188>  
Email: [kdguedes@gmail.com](mailto:kdguedes@gmail.com)

**PhD. Arkley Marques Bandeira**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.  
ORCID: <https://orcid.org/0000-0002-7646-7526>  
Email: [arkleymbandeira@gmail.com](mailto:arkleymbandeira@gmail.com)

**Msc. Vanderley Rabelo de Jesus**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.

ORCID: <https://orcid.org/0000-0001-7955-1638>

Email: [vanderleydejesus21@gmail.com](mailto:vanderleydejesus21@gmail.com)

## **Abstract**

Discussion about tourist events and other forms of socialization that take place in the Historic Center of São Luís – located in the State of Maranhão, in Brazil – which, in turn, give rise to collective tourist experiences linked to Historical Heritage. The aim of our work is to highlight the role of these events in the composition of collective heritage interactions, enhancing the general notion about the importance of preserving historic spaces and monuments. It addresses concepts of themes such as experience, heritage, and tourism, with an emphasis on the narrative of collective experiences. With a descriptive and analytical focus, it uses bibliographic material from authors who address the issues pertinent to the study and also analyzes the data collected through field research made with residents who participated in tourist events and socializations in the Historic Center of São Luís. These gregarious interactions are believed to promote the materialization of a collective feeling of belonging with the heritage.

**Keywords:** Collective experience. Tourist events. Patrimony. Historic Center of São Luís.

## **1. Introduction**

Experience is key to the materialization of the comprehension that an individual has over a certain theme. This happens because human beings are prone to overlook or disregard the value of things and facts that were not explained to them in a concise or detailed manner. However, once they experience these things, they acquire a greater propensity to attribute value and meaning to things. This happens frequently in the notion that people have regarding historical heritage, that, in turn, is articulated with the disposition – or not – of these individuals to patrimonial preservation.

The development of events focused on tourists and on other types of socialization actions in historical spaces allows people to build up experiences with the patrimony that are carried out in a collective manner and that, consequently, also materialize collective notions of patrimony preservation, since the individuals have access to the patrimony within the same activity and in a similar temporal context.

This study aims to analyze how these collective experiences provided by touristic events and other socialization actions in historic spaces can be significant for heritage preservation policies, considering the power of awareness that resides in collective movements of action on the patrimony. From this problematic, using bibliographical research – with a documentary research step and empirical work – we sought to comprehend the impact on the formation on patrimonial notion of people who were present in projects and events held on the Historical Center of São Luís, having as of object of the analysis the projects Quarta do

Tambor (Wednesday of the drums) and Sarau Histórico (Historic soirée), that take place in the space Casa do Tambor de Crioula and the Deodoro Square, respectively.

This study brings an important contribution to the debate on patrimonial preservation policies, as it embarks on a new path of understanding of experiences with the historic heritage, showing its interdisciplinary by incorporating the theme of tourism and its developments in the process of the scientific investigation of collective experiences within historical spaces.

## **2. The patrimony and the social experiences**

The discussions about the historic heritage have deepened over the years and have always brought along with them countless meanings about their concepts, origins, and preservation policies. The intention has always been to establish for individuals, who by chance have access to historical heritage, a form of interaction with the historical monuments that were appropriate and cohesive to the function of patrimonial preservation.

The patrimony acquires a transforming function of the experiences of their visitors, giving authenticity to the visits to the Historical Centers of the cities. However, little is said about how the experiences of these individuals alter the collective perceptions regarding the patrimony, creating new forms of interaction with these historical monuments, in which the experiences are not only guided by the norms established for the preservation, but become themselves the new north of these policies.

Heidegger (1987), defines experience as a phenomenon that presents reflexive patterns and that has the potential to transform the human being, having the power of provoking significative effects on the manner those who suffer the experiences starts to face the events in their surroundings. Thus, the person who have the experience not necessarily it the active element of the happening. In many cases, the experience happens by means of an spontaneous process, in which the residents can be transformed by the way these experiences are presented to them.

It is important to highlight that, when speaking about experiences, there are a group of aspects that need to be further discussed, considering that inside the movement of experiencing that are countless theoretical and epistemological elements that need to be understood in order to comprehend in the existing dimension of the structure of the experience, one of the most important being the complex and non-linear issue of subjectivity

For Foucault (2004), the subjectivity is constituted through techniques of the self, in which the subject build himself up with experiences, inside a set of procedures in which the subject coexist with problems and constraints, which are capable of changing the subject. According to the author, the antipersonification is the first condition of the possibility of existence, even though this condition brings, simultaneously, possibilities of resistance, in which the existence of other individuals is essential to the process of self-constitution. Therefore, the subjectivities are in constant transformation and have direct articulation with the historical and affective territory where they are located. (FOUCAULT, 2004).

Another major element in the experience is communication, being it, according to Mead (1992), a specific experience that helps in the construction of the subject according to their interactions with other subjects. Communication allows that the individuals give greater meaning to their experiences, expressing constantly

the notion of self and the notion that they have of others, They stop to have their experiences measured by their actions and start to measure them mostly by their interactions (SHEPHERD, 2005).

Thus, the experience developed within spaces in the Historic Center of São Luís tends to be more significant when shared among a group of people as it allows for the sharing of subjectivities through communication in this process of interaction with the built heritage. The collective experience materializes the sense of heritage according to individual subjectivities, which, through an intense process of living, are directed towards an exchange of significant experiences for the preservation of what they see as historical heritage. According to Poulot (2009), the history of heritage is intrinsically linked to the way society builds it and, therefore, it remains alive thanks to the practices of memory articulated with the identity processes that are transmitted. Thus, heritage becomes everything someone says and does in respect to it, expanding the sense of inheritances that were and are claimed or appropriated (NETTO, 2020).

Tourism enters this scenario as a support element for the dissemination of these experiences and collective experiences with the heritage, as it uses its dimension as a consumer of historic spaces to promote collective events and socializations that facilitate the gregarious experience and interaction with the built monuments, being able and constantly strengthening itself as a disseminator of heritage preservation within the Historical Center of São Luís.

### **3.The Historic Center of São Luís: tourist movement and preservation of historical heritage**

The effects of modernization and urbanization in historic centers can be irreversible, and can cause many changes in the built heritage of these urban sites, mainly due to the fact that people value modernizing features much more than the historical aspects of buildings. In São Luís, although the Historic Center has preserved many of its elements that give it identity and uniqueness, especially with regard to its construction techniques – 17th century urban mesh and its original architectural ensemble (IPHAN, 2019) – the region had its preservation as the stage for countless moments of conflict, caused by the urbanization and modernization process of the city.

These urban interventions made in favor of the revitalization of the Historic Center of São Luís created a positive scenario for the incorporation of tourism, opening spaces for expressions of interest from funding bodies, which, consequently, brought new interventions and the strengthening of the preservation of the whole architectural complex (SILVA, 2009). Tourist events and activities come to live together, not only with the built heritage, but also has influences on preservationist policies.

In this context, the policies for the preservation of the architectural heritage of the Historic Center of São Luís started to articulate themselves with policies aimed at leisure and tourism activities. This has been evident since the 1970s, when, according to Aires (2007), the preservation of Maranhão's identity and the ideal of development based on tourism has come to figure, in a very articulated way, the focus of public policies.

In 1995, the Plano Estadual de Turismo (State Tourism Plan) was elaborated, favored by the context of advancing tourism in the northeastern region of Brazil. Created with the aim of raising funds from federal policies at national and regional levels, the plan is configured as a proposal for tourism planning for the

development of activity in the State. In 2000, the plan is presented again with the name of Plano de Desenvolvimento Integral do Turismo no Maranhão (Plan of Integral Development of the Tourism in Maranhão), popularly known as Plano Maior (Major Plan) (MARANHÃO, 2000).

With the creation of the Plano Nacional de Turismo (National Tourism Plan), at a time of great appeal for the development of tourism, the city of São Luís was among the most important tourist centers in the state. Shortly, the Historic Center, holder of a rich historical and cultural collection, started to have its spaces more and more appropriate for tourist purposes. According to Costa (2015, p. 20), the plans “therefore appear as instruments that drives the appropriation of these spaces by and for tourism, changing the use of the territory, producing new materiality and/or enabling new speculative arrangements.”.

Considering this, the Historic Center became strongly linked to the tourist activity, having its spaces more and more occupied by projects and leisure and tourism actions directed, mainly, for the consolidation of the region as a tourist attraction territory. This is still a reality in the region, constantly presenting a dichotomous scenario in the way that tourist activities and other socializations are linked to the historical heritage.

For this reason, while considering the negative transforming dimension of the space that comes with tourist activity, the study seeks to raise an alternate way to develop collective synergy during the socializations promoted by the tourism events and direct it to the formation of the also collective notion of patrimony preservation, where significant and gregarious tourist experiences will help to attribute value to the heritage of the Historic Center of São Luís, Maranhão.

### **3.1 Tourist events and socializations in the Historic Center of São Luís**

Events have always played an important role in the socialization of individuals in a particular group or society. Through leisure, entertainment or even business activities, it allows a good number of people to interact with each other and with the spaces in the city where these events are held, enhancing the social experiences of these individuals. According to Dubar (2005, p. 23), socializations are not only about the transmission of values, rules and norms, but also englobe the development of some kind of representation of the world. Socializing “is a process of identification, of construction of identity or, in other words, of belonging and of relationship.” (Dubar, 2005, p. 23).

In the case of the events held in the Historic Center of São Luís, which are strongly articulated with the historic spaces, these activities allow local residents to develop intimate relationships with the spaces of this region, rediscovering their locality and assigning, through more sensitive and targeted processes of interaction, value to the historical monuments present in these experiences. For Hamam (2011), the event is characterized by being one:

[...] exceptional event previously planned, which occurs at a certain time and place and generates great involvement and mobilization of a group or community, seeking integration, diffusion, and awareness among the participants towards the intended objectives. These must be placed in a clear and explicit way, so that the target audience receives and assimilates the topics covered and the actions developed during the events (Our translation). (HAMAM, 2011, p. 130).

Thus, events in historic spaces can be directed towards creating a chain of dissemination and collective awareness about heritage. However, in a context where all sectors of society are affected by capitalist intentions, the heritage experiences provided by events and other tourist activities also tend to reproduce the fragmented and individualistic structures of this systematic type of content production and reproduction. For this reason, there is an inclination towards individualistic practices of interaction with historical heritage, which makes it difficult, among other elements, to form a collective belonging to the Historical Heritage of São Luís do Maranhão.

As Lima and Magalhães (2010) clarify, the new forms of sociability in the spaces of the modern city are incompatible with the transmission of experiences between new and old subjects, which favors the predominance of very individual experiences. Thus, experience is no longer the only way to get to know the modern city. Those experiences that referred to individual and collective memory and that, therefore, fostered reflection and feeling give way to experiences that rest on distracted attention, with absorption of passive, scattered and secondary knowledge. Tourist events and other socializations appear as an alternative for the promotion and development of collective initiatives to access historical heritage, constantly introducing meaning and value in the materialized interaction between individuals, tourist events and patrimony in their surroundings.

#### **4. Methodology**

Our research has a qualitative approach, since the qualitative research that is closer to the interpretive intentions of the study, according to Silva (2001, p. 20), “considers that there is a dynamic relationship between the real world and the subject, that is, an inseparable link between the objective world and the subjectivity of the subject that cannot be translated into numbers”. According to its technical procedures, the research required a stage in which documentary sources were used, since documents such as magazines, articles and public power notices were raised to analyze the selected projects. It is classified as an exploratory case study. Gil (2002, p. 41) points out that exploratory research “has as its main objective the improvement of ideas or the discovery of intuitions.”.

The object of our research are 2 (two) leisure and tourism projects that are carried out in the spaces of the Historical Center of São Luís. The projects Quarta do Tambor, with coordination at the state level through the (SECMA), and Sarau Histórico, coordinated in the municipal level by means of the Secretariat for Municipal Tourism (SETUR São Luís). The projects were selected due to their operating configurations that allow collectives of people to experience and interact with tourist and leisure events held in spaces in the Historic Center.

The study sought to address the local agents responsible for the appropriation of public spaces in the Historic Center of São Luís, who are the social beings (residents present during the realization of the projects). It also included the managers of state institutions that are responsible for planning and managing tourism and leisure projects directed to these spaces in the Historic Center of São Luís, represented here by a government employee from the Secretariat of State for Culture of Maranhão and another employee of the Secretariat for Municipal Tourism (SETUR São Luís).



The analysis procedure was done in a qualitative way, in which the analysis structure stipulated by Miles and Huberman (1994) could be used. The qualitative analysis is divided into three stages, denominated a) reduction (selection and organization) data; b) exhibition (classification and data layout) and c) conclusion/verification (review and validation, interpretation and analysis).

## **5. Collective Heritage Experiences: experience collectively to constantly preserve**

In order to build a collective notion about the importance of heritage preservation, it is necessary that as many people as possible be subjected to processes of coexistence and social interaction that are significantly articulated with the built heritage. With an important contribution from the tourism sector, it is possible to create events and socializations in historic spaces in cities that guarantee the integration of diverse subjectivities through moments of communication and sharing of identity notions, which will certainly contribute to the strengthening of preservation of the historical patrimony policies.

Elias (2017) states that society only exists because there is a large number of people and it continues to function due to the inclination that these people have to crave and accomplish certain things. Within the spatial limits of a city, there are several political, cultural and social movements that reflect the way in which this particular society organizes, articulates and constructs its senses, both in relation to city spaces, as well as in the way the subjects themselves relate to these spaces and among themselves.

Individual experiences, although important for the construction of identity, may not be as effective in the process of materializing a general notion of heritage preservation, since subjectivity based on a social individualism makes it difficult to expand common goals in relation to the preservation of built heritage.

Based on this notion, an analysis is made of the contributions that tourist events and other socialization in the spaces of the Historic Center of São Luís bring to the notion of heritage preservation. To this end, a study was undertaken on tourism and leisure projects that give rise to meetings of large numbers of people who experience the spaces of the Historic Center and come into contact collectively with the historical monuments present in the region.

The project Quarta do Tambor de Crioula has two categories of activities, the workshops that contain practical and theoretical activities related to dance, singing and percussion, which aim to enable contact and experience with the theme of traditional knowledge of the practice of Tambor de Crioula typical of the state. And it also has the very manifestation of the Tambor de Crioula, which can be presented by groups of manifestations inspired by African culture, but that are also genuinely from Maranhão and present the particular characteristics identified in the way of doing of the State (MARANHÃO, 2019).



Figure 1: Performance of *Tambor de Crioula* in the space *Casa do Tambor de Crioula*

The project provides an individual experience that comes close to the other experiences of other individuals present and that are integrated by means of communication and interaction processes that take place among participants with their peers, in the relationship between tourists and local residents and also between the social beings and the spatial context where the manifestations are performed.

The Sarau Histórico is a project coordinated by the Municipal Government, by means of the Secretariat for Municipal Tourism. The project is part of the Reviva Program and consists of a cultural mix of literature, theater, music, and history, aimed at the local community, visitors and tourists (MARANHÃO, 2017). Within its structure, the event manages to gather a significant number of people in the Deodoro Square who then share an experience based in very similar contexts, in which they learn about the history of the city within an environment surrounded by historical monuments.



Figure 2: Presentation of the project Sarau Histórico in the Deodoro Complex

According to the government employee of the Secretariat for Municipal Tourism, the Sarau Histórico was started in 2016, idealized by the then Secretary for Municipal Tourism, Socorro Araújo, and during the execution of the project, actors are characterized with period clothes and make a poetic tour of the golden

past of the city. The manager points out that the activity started to take place in the Benedito Leite Square, another historic space in the city, and aims to convey a sense of nostalgia to the spectators, while promoting the learning of the history of São Luís and interaction with the surrounding historic spaces.

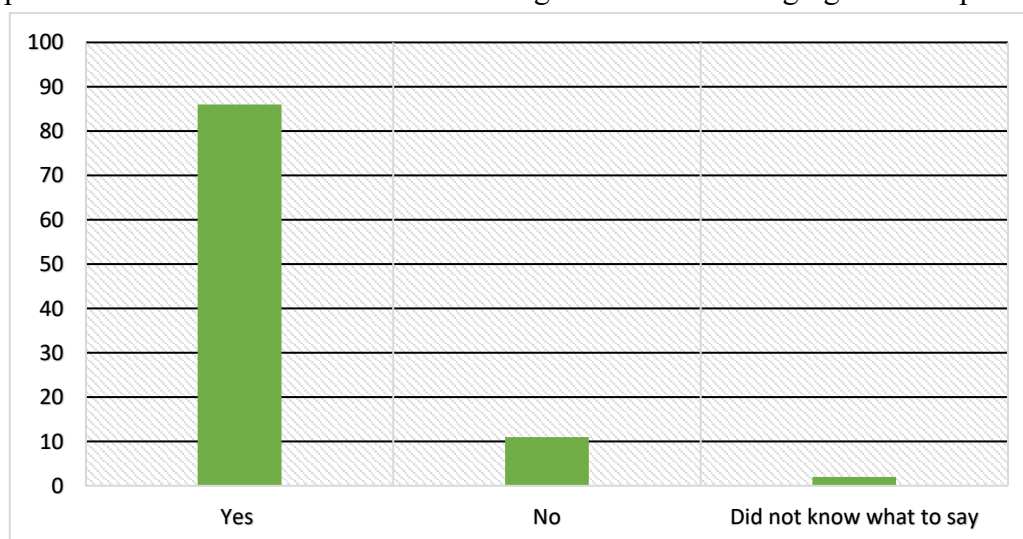
The Sarau Histórico is characterized as a thematization of the local history and culture with the purpose of benefiting the local tourism and leisure activities. According to Valls (2006, p. 32), thematization is based on the recreation of spaces and sensations based on intensive contributions referring to other areas, places or times. The most effective components "are the recreation and animation of characters, natural spaces and monuments, elements of traditional culture, art, gastronomy etc, which intertwine to provoke the experiences."

These projects became democratizing vectors of the spaces in the Historic Center of São Luís, enabling the expansion of access to these sites in the city. People start to frequent these spaces to honor events, which gives rise to the gregarious experiences that significantly contribute to the construction of the perceptions that residents and visitors acquire of the city, bringing them closer to the collective will to preserve the heritage present in the Historic Center of São Luís and that serves as a stage for the realization of activities such as the Sarau Histórico and the Quarta do Tambor.

This is a simple equation, because as Harvey (2000) says, urban projects must be more sensitive to local cultures and histories, conceiving specialized architectural forms that can vary from intimate spaces to spectacles, from the modern to the oldest. He emphasizes that the built environment constitutes an element of a set of urban experiences, vital to work on new cultural aspirations. The way in which the spaces of a city are organized forms a material basis from which it is possible to think and realize new social sensations and practices (HARVEY, 2000), among these new social attitudes, we can list the culture of preserving history reflected into historical monuments.

Asked about their agreements regarding the potential of the experiences lived in the projects Quarta do Tambor and Sarau Histórico as instruments to foster the safeguarding of the historical heritage, most of the participants present consider that events and socializations in the Historic Center bring residents closer to historical monuments, sensitizing them to the practice of heritage preservation.

Graph 1: Events in the Historical Center and generation of belonging with the patrimony



Source: Drawn up by the authors (2019)

In this sense, the use of tourist events and other forms of socialization in the Historic Center as an instrument for materializing feelings of belonging is a task that starts from the very capacity of city managers and agents who preserve the heritage to know the aspirations and perceptions of social beings on the built heritage. According to Lang (1987), the perception of space is articulated with the stimuli that guide the behavior of each individual, in which the spatial quality and attractiveness of a public space is measured according to the users' physiological, sociological and psychological needs who then shift to the use and appropriation of this space (HAAS, 2000).

The participants of the project understand that these initiatives promote changes in people's behavior in relation to heritage, because within a collective process of interaction with monuments their needs and subjective perceptions are integrated and can form a set of preservationist interests that, together with initiatives of heritage education, can give meaning to the execution of the projects carried out in the Historic Center of São Luís.

Thus, it is necessary to establish an intense link between the ordination of historic spaces and the experiences present in the routine of groups of individuals in the city of São Luís. In this more fundamental and everyday experience of public socialization, the demands of belonging are scattered and fragmented in the city space, "whose demands are associated with the ways of being in the city, of occupying places and transit in spaces that encode and make public these demands for rights and for the different meanings of belonging. (Our translation)" (LEITE, 2007, p. 46).

Therefore, the interactions between individuals at tourist events and other socializations in the Historic Center of São Luís are responsible for collective experiences that can be a multiplying factor in the culture of preserving historical heritage. This, because "the attitudes that the individual learns through socialization generally relate to broad systems of meanings and values, extending far beyond their immediate situation." (BERGER, P., BERGER, B., 1977, p. 214). These experiences are full of meanings and subjective processes that, if used correctly and directed towards a specific objective, can help to build a sense of belonging with the built heritage and lead to its constant maintenance by the local residents.

## **6. Conclusion**

The importance given to the preservation of the built heritage is intricately linked to the ability to transform experiences in historic spaces into meaningful socializations. The collective interaction with the spatial dimensions of heritage enhances an expanded sense of belonging, as individuals present in this collectivity end up sharing subjectivities and integrating perceptions about heritage preservation, culminating in positive contributions to preservation policies.

Tourist events and other socializations that guarantee the contact of a large number of people within tourist spaces can be a first step in this process, which will be completed with processes of communication and sharing of values, meanings and identity elements that will favor the constant maintenance of monuments of the Historic Center of São Luís.

The projects Quarta do Tambor e Sarau Histórico are good and necessary initiatives that guarantee activities that lead residents, tourists, and visitors to live experiences within historic spaces. They are examples of methodologies that can contribute to the preservation of São Luís' heritage, giving space for many other



initiatives to promote collective experiences articulated with the built heritage, always developing new ways to make the most of social subjectivities.

The collective experiences with the heritage promoted by tourist events and other forms of socialization must be seen as effective tools in the construction of a solid culture of preservation of historical monuments, not only in São Luís do Maranhão, but in many other cities in Brazil, especially those that have Historical Centers and lack policies that innovate daily in the task of safeguarding historical heritage.

Tourism stands out for its aggregating and consuming character of spaces in historic cities that are tourist destinations, not only because it is a social phenomenon but also because it integrates different individuals worldwide, however, there are other alternatives of socializations that can promote experiences with the heritage, which may be the subject of further discussions within the context of heritage preservation.

## **Acknowledgment**

Publication funded by the financial aid for CAPES financing research (Finance code 001) according to CAPES Ordinance 206. In accordance with Internal Call No. 01/2020 of the Graduate Program in Culture and Society of the Federal University of Maranhão (PPGCult / UFMA), regarding Payment of Financial Aid to the Researcher of the Graduate Program in Culture and Society (PPGCult) from the Federal University of Maranhão.

## **7. References**

- Aires, E. Interesses políticos nas cenas do patrimônio histórico cultural: o caso de São Luís, “Patrimônio da Humanidade”. Vol. 01. São Luís: Outros Tempos, 2007.
- Berger, P., Berger, B. Socialização: como ser um membro da sociedade. In: Foracchi, M. L. E Martins, J. S. Sociologia e sociedade. Rio de Janeiro, LTC, 1977, p. 200-214.
- Costa, C. R. R. O litoral do Maranhão, entre segredos e descobertas: a fronteira de expansão do turismo litorâneo na periferia do Brasil. Tese de Doutorado. Programa de Pós-Graduação em Geografia Humana. Faculdade de Filosofia, Letras e Ciências Humanas da Universidade de São Paulo. São Paulo, 2015.
- Dewey, John. Democracy and Education. Pennsylvania: Pennsylvania State University, 1916.
- Dubar, Claude. A socialização: construção das identidades sociais e profissionais. São Paulo: Martins Fontes, 2005.
- Elias, Norbert. A Sociedade dos Indivíduos. Rio de Janeiro, Jorge Zahar Editores, 2017. (Parte I – A Sociedade dos indivíduos).
- Foucault, Michel. A hermenêutica do sujeito. Trad. Marcio A. da Fonseca e Salma T. Muchail. São Paulo: Martins Fontes, 2004.
- Gil, A. C. Como elaborar projetos de pesquisa. 4. ed. São Paulo: Atlas, 2002.
- Harvey, David. Condição pós-moderna: uma pesquisa sobre as origens da mudança cultural. São Paulo: Loyola, 2000.
- Hamam, R. “O evento integrando o mix da comunicação”. In: Kunsch, M. K. (Org.). Obtendo resultados com relações públicas. São Paulo: Cengage Learning, 2011.

- Haas, K. E. Espaços abertos: indicadores da apropriação interna e a adaptação dos usos do entorno. 2000. 248 p. Dissertação (Mestrado em Planejamento Urbano e Regional), Universidade Federal do Rio Grande do Sul, 2000.
- Heidegger, Martin. La esencia del habla. In: HEIDEGGER, M. De camino al habla. Barcelona: Ediciones del Serbal, 1987.
- Iphan. Centro Histórico de São Luís (MA). Instituto do Patrimônio Histórico e Artístico Nacional (Iphan), 2019. Disponível em: <<http://portal.iphan.gov.br/pagina/detalhes/34>>. Acesso em: 03 de mai. de 2019.
- Lang, J. Creating Architectural Theory: the role of the behavioral sciences in environmental design. New York: Van Nostrand Reinhold Company, 1987.
- Leite, Rogério Proença. Contra-usos da cidade: lugares e espaço público na experiência urbana contemporânea. São Paulo: Editora da UNICAMP; Aracaju, Sergipe: Editora UFS, 2007.
- Lima, F.; Magalhães, S. Modernidade e Declínio da Experiência em Walter Benjamin. In: Acta Scientiarum. Human and Social Sciences. vol.32, nº2, p. 147-155, 2010. Disponível em: <<https://www.redalyc.org/pdf/3073/307325336004.pdf>>. Acesso em: 28 de ago. de 2020.
- Maranhão. Gerência de Planejamento e Desenvolvimento Econômico. Plano de Desenvolvimento Integral do Turismo no Maranhão: Plano Maior. São Luís: GEPLAN, 2000.
- Maranhão. Secretaria De Estado Da Cultura. Casa do Tambor de Crioula do Maranhão. São Luís, 2019. Disponível em: <<http://www.sectur.ma.gov.br/casa-do-tambor-de-crioula-do-maranhao/#.XWnwcDZKhPY>>. Acesso em: 30 Ago. 2019.
- Maranhão. Secretaria De Turismo E Cultura. Revista Cultura e Turismo. São Luís, 2017.
- Mead, George Herbert. Mind, Self and Society – from the standpoint of a social behaviourist, Chicago and London: The University of Chicago Press, 1992.
- Miles, M. B.; Huberman, A. M. Qualitative data analysis: An expanded sourcebook. Thousand Oaks: Sage, 1994.
- Netto, R. et. al. Curso Formação de Mediadores de Educação para Patrimônio. Fortaleza, CE: Fundação Demócrito Rocha, 2020.
- Poulot, Dominique. Uma história do patrimônio no Ocidente. São Paulo: Estação liberdade, 2009.
- Rodrigues, Adriano Duarte. O Paradigma Comunicacional. Lisboa: Fundação Gulbenkian, 2011.
- Silva, Edna Lúcia da. Metodologia da pesquisa e elaboração de dissertação. Florianópolis: UFSC, 2001.
- Silva, J. R. C. A construção do patrimônio: a trajetória de preservação do acervo arquitetônico e paisagístico do centro histórico de São Luís. Dissertação de Mestrado – Programa de Pós-Graduação em Ciências Sociais, Universidade Federal do Maranhão, São Luís, 2009.
- Shepherd, Gregory. Communication as Transcendence. In: Communication as – perspectives on theory. London: Sage, 2005. pp. 22-30.
- Valls, Josep-Francesc. Gestão integral de destinos turísticos sustentáveis. Trad. Cristiano Vasques e Liana Wang. Rio de Janeiro: Editora FGV, 2006.



# **Freedom and Truth in Public Sphere, and the Contest of Fake News: A Reflection from Kant and Hannah Arendt**

**Zilmara de Jesus Viana de Carvalho**

Professor the Philosophy, Dept. of Philosophy and Graduate Program of Culture and Society, Federal University of Maranhão (UFMA)

**Matheus Costa e Costa**

Graduate Program of Culture and Society, Interdisciplinary Master, Federal University of Maranhão (UFMA)

**Rayssa Marchão Araújo**

Graduate Program of Culture and Society, Interdisciplinary Master, Federal University of Maranhão (UFMA)

**Kamila Fernanda Barbosa Sampaio**

Professor of the Philosophy Course, State University of Maranhão (UEMA), Brazil

**Flávio Luiz de Castro Freitas**

Professor of the Degree Course in Human Sciences and Graduate Program of Culture and Society, Federal University of Maranhão (UFMA)

## **Abstract**

*It aims to address the freedom of speech issue from a Kantian point of view, based on the concepts about public use of reason and thinking for oneself, the required conditions for publicity and its relation to fair, as opposed to the unfair and the lie. Moreover, this study addresses the problem of factual truth within the political sphere linked to the use of lies in the different means of communication, and how the fake news reveal themselves as dangerous to the current democratic states, it has, regarding this point, as the main theoretical framework Hannah Arendt's teachings.*

**Keywords:** Factual Truth, Politics, Lie, Freedom of Speech, Autonomy, Fake News

## **1. Introduction**

The ethics in the media gained a new highlight with emerge of social networks. Currently, such media have a great importance in the political world, they help people's articulation for the defense of their collective interests, as well as the exercising of power inspection. However, it is a favorable space for manipulation of facts and organized lies that help the formation of public opinions mainly derived from

political authorities.

Firstly, this article addresses the freedom of speech issue and, thus, the public use of reason as an expression from the German philosopher Immanuel Kant, author of enlightenment era, who defends this means as essential for the process of enlightenment. For this purpose, this study emphasizes the inseparable relationship between freedom of thought and freedom to communicate thought, as well as the aim regarding public use of reason and the limits that they are.

Furthermore, it treats the issue of ethics in means of communication from the perspective of Hannah Arendt's contemporary thought, a philosopher who analyzes how the factual truth can be manipulated and destroyed by power within the political sphere. Based on this, it presents a reflection in parallel with the contemporary and political phenomenon of post-truth, political figures throughout the world practice it, they use fraudulent news not aiming common good, but to achieve, in the best way, interests of those who exercise and rule the political power.

## **2. The Use of Reason and Freedom of Thought**

The German philosopher of the enlightenment, Immanuel Kant (1991, p.98), in his opulent *An Answer to the Question: 'What is Enlightenment?'*, affirms that the enlightenment is man's exit from his self-incurred immaturity which himself is the guilty, in the case of its cause is not in the lack of understanding, but in the lack of decision and courage to use own understanding without the aid of another. Nevertheless, for enlightenment only freedom is necessary, and its most inoffensive way is what we call of freedom to make public use of reason about all issues.

Even with limits of freedom everywhere, the public, especially in the condition of erudite, should submit only to their own reason. Sometimes, the private use of reason can be limited, yet it does not prevent the enlightenment. However, the enlightenment happens through the public use of reason that always must be free. *Sapere aude!* As Kant said, dare to think and it is the motto of enlightenment. Therefore, as Bobbio (2000, p. 243) rightly points out the freedom of thought is fundamental to achieve enlightenment. According to Bobbio, Kant was extremely aware of the importance of enlightenment values which he interpreted as the base for humanity emancipation. The freedom of thought was in the basis of all others. The state that was inspired by the freedom of thought should require, as a state, total obedience. On the other hand, as a promoter of enlightenment, the state must give for citizens the possibility of exit from immaturity and become rational beings through the freedom of thought.

In this regard, Kant in his text *What Does It Mean to Orient Oneself in Thinking?* strongly defends the freedom of thought, he affirms that it is intrinsic to the communicability of what one thinks; so who abdicates or is prohibited of freedom to speak also is deprived of own freedom of thought, since "how much and how correctly would we *think* if we did not think as it were in community with others to whom we *communicate* our thoughts, and who communicate theirs with us!" (Kant, 2001, p. 16). *On the Common Saying* he reaffirms this aspect to declare: "For it is the natural calling of humanity to communicate with one another, above all about what concerns the human being in general" (Kant, 2006, p. 56).

In addition to the freedom of speech defense regarding the public use of reason, there is in Kantian thought the recognition and defense of obedience to the state. According to Bobbio (2000, p. 241), Kant in fact believed that citizens should obey the state in an absolute way; but at the same time, they had the right to publicly express their thoughts about laws. In other words, use their own reason. Furthermore, according to Kant, the quality of a citizen never should be decoupled from the quality of being rational.

So, Immanuel Kant strongly defends the obedience to the state, as well as the men's freedom to publicly use their own thought. In the text *What Does It Mean to Orient Oneself in Thinking?* the philosopher emphasizes the importance of thinking for yourself as much as the obedience to constitutional political power. About thinking for oneself, he affirms:

*Thinking for oneself* means seeking the supreme touchstone of truth in oneself (i.e. in one's own reason); and the maxim of always thinking for oneself is enlightenment (...) To make use of one's own reason means no more than to ask oneself, whenever one is supposed to assume something, whether one could find it feasible to make the ground or the rule on which one assumes it into a universal principle for the use of reason. This test is one that everyone can apply to himself; and with this examination he will see superstition and enthusiasm disappear, even if he falls far short of having the information to refute them on objective grounds (Kant, 2001, p. 18).

This analysis involves politics, considering that we should use the enlightened reason and this thinking for oneself in the political sphere to evaluate if the legislation that sovereign proposes can become a universal principle. Clearly, when citizens note that it cannot, they should use their freedom of speech, and submit the law to public analysis, which as a law emerges from general will.

As François Calori (2015, p. 99) clarifies that it is not only about the defense of publicity by public right, but it strictly binds its transcendental method. Kant (2006, p. 104) in *Toward Perpetual Peace* enunciates this method: "All actions that affect the rights of other human beings, the maxims of which are incompatible with publicity, are unjust." This principle that has an ethical as much as legal nature is just negative, since it leads to recognize what is not fair regarding others. So, in this respect, it is unfair every:

(...) maxim explicitly without thereby thwarting my own aim, if it must rather be *kept secret* if it is to succeed, if I cannot *admit it publicly* without thereby inevitably provoking the resistance of all others to my plan, then the necessary and universal and hence *a priori* understandable opposition to me can be due to nothing other than the injustice with which my maxim threatens everyone (Kant, 2006, p. 105).

According to Calori (2015, p.99) it does not mean that every political maxim should be claimed in public, but only that should be one. Therefore, if one maxim cannot become public and we should keep it in secret, certainly the reason is that it will bring damages to everyone, hence it is unfair.

For Kant it is acceptable that the chief executive allows people express their thought, even when they are under coercive laws, as effect he says: "In every commonwealth there must be *obedience* under the mechanism of the state constitution in accordance with coercive laws (which apply to the whole). But there must also be a *spirit of freedom*" (Kant, 2006, p. 58). In other words, the obedience to established laws should not be an obstacle to the public use of reason and the expression of critical freedom, as well as the public use of reason should not oppose the compliance with established laws: "Argue as much as you

like and about whatever you like, but obey!” (Kant, 1991, p.100) Regarding the affirmative that we should ratiocinate, but obey, Norberto Bobbio (2000, p. 242) comments about the meaning of the subject must obey and ratiocinate. He affirms that on one hand, as a private citizen, the subject should obey, and respect the standards of law; however, as man’s reason, the subject should publicly use one’s reason. It means that the subject criticizes those same laws which he respects, if believes they are unfair. As a result, the citizens’ rights to publicly express their own thought is necessary, also the sovereign should not hinder it with condemnations or other ways to reprimand.

Kant understands the freedom of thought, here you can interpret as the freedom to communicate thought. Thinking and communicating cannot be decoupled as a way for people’s enlightenment, such as he says in *The Conflict of the Faculties* that “Thus the prohibition of publicity impedes the progress of a people toward improvement” (Kant, 1979, p. 161). Even so, we never should use the freedom of speech in law without prudence and let alone with purpose of damaging others. It also should not be a tool for the distribution of fraudulent news for promotion of lies which can easily be applied to what we know today as fake news.

In the work *On a Supposed to Tell Lies from Benevolent Motives*, the German philosopher analyzes the lie from a legal point of view, in other words, if the lie is conforming to a positive right. Kant (1909) concludes that give true statements, while we can avoid it, is a man’s formal responsibility to others, regardless of the damage that it can cause to himself or another man. It refers to the field of law, in the ethics sphere the lie would be a violation of duty for oneself. Still about the lie, the philosopher in *Groundwork of the Metaphysics of Morals*, Kant assures:

Then I soon become aware that I could indeed will the lie, but by no means a universal law to lie; for in accordance with such a law there would properly be no promises at all, since it would be futile to avow my will with regard to my future actions to others who would not believe this avowal (1998, p. 15).

Kant says the lie is always a declaration made by someone else that is not true, it is not necessary to add that this declaration should damage another man, since the lie always damages someone, even if it is not a specific person, but humanity in general, when people disable the source of law and put all contracts under suspicions. The duty of being honest is a sacred commandment of reason that unconditionally commands; the lie which conversely harms the entire legal order.

For Kant, the freedom to publicly express in no way can be associated with the idea of the act without prudence to civil law to disseminate untrue information. Furthermore, as free thought it is submitted to the law that reason gives to itself and the lie is a maxim that never can be universal. Strictly about the ethical duty, the lie is a violation of duty for itself. Then, lie is a maxim that never can be universal, its use is ethically reprehensible. On the other hand, the possible damages that come from lie to members of society could become the author susceptible to legal punishment, such as the case of false testimony in a trial, a lie that leads to obstruction of justice, or the manipulation of public opinion that incites to rebellion.

The great information flow and mass media are characteristics of the current context provided by diverse technological advances and beyond doubt, the internet is the most significant of all. Through the internet, billions of people connect to a global network every day from the most different places and devices. Many people use anonymity in social networks and associate the freedom of speech with the idea

of express their right to talk about absolutely everything they want without prudence to laws, or even use public space to disseminate false information with the aim of prejudice against someone. If we analyze such practices from a Kantian point of view, it would be disallowed from a legal and an ethical perspective, since it would cause damage to civil society and humanity, in a general way. It damages the fundamental premise of publicity: the human progress toward better. Moreover, the dissemination of these lies used to formation of public opinion would be an expression of despotism which are subordinated to citizens, it is worth remembering the essay about *Enlightenment* which Kant (1991, p. 103) about the people's tutors and regarding spiritual matters, says that the fact of people shall be immature "is an absurdity which amounts to making absurdities permanent". Here is the exact expression: "the blind leading the blind".

The use of an immoral theory of prudence contributes a lot to the comprehension of this corruption. Ricardo Terra (2012, p. 132 – 133) rightly remembers that prudence is a political virtue. From the appropriate knowledge of natural mechanism without giving up of pure and fundamental right result the good politic, the good use of prudence, and the policy produced by the moral politic that aims, according to Ricardo Terra, citizens' well-being; but only see its acquisition in the addition of action that has as starting point the right. However, an immoral theory of prudence can set up, men who are imbued with this theory, according to Kant, can honor the right to themselves, but in practice, they frame apologizes to keep distance of right, they "invent hundreds of excuses and deceptions in order to avoid it in practice and to ascribe to brute force the authority of being the source and unifying bond of all right" (Kant, 2006, p. 100).

Kant denominates these men of political moralists, as they subordinate principles to their aims, and they do not measure efforts to execute their own interests. The concealment promotes a certain opacity as a supply of thought that is present in social relationships as much as in the public sphere, Kant accepts this as a characteristic for keeping a possible and civilized necessary life in society within the limits of decency, it extrapolates this function when the right is subordinate to the aims of political moralist, so it moves on to a level which the practice can be classified as dishonest. Obviously, we cannot rule out the dissemination of lies that manipulate the public opinion to the point of creating a sedition, it is among strategies adopted for the reach of hidden political purposes. It constitutes as maxims that should be kept in secret, and cannot be publicized, under penalty of attracting the opposition of everyone against itself, these maxims are arranged in the shadows where any light can be mistaken with a shiny another, but when submitted to the touch of a stone in a way of publicity, using the Kantian expression, it "is nothing but pure outward show and shimmering misery" (Kant, 2006, 12).

It is always appropriate to remind that the thought while being communicated in the public sphere shows openness to dialogue, analysis, counterargument so far from a solipsistic monologue pretentious true. When the aim is enlightenment, namely increase the autonomy of thought, we should distrust of every speech that announces itself as unquestionable truths to follow, the fetters of immaturity strengthen these truths. Evidently, the Prussian philosopher that strongly defended the public use of reason and combated the lie, also warned about its ethical and legal ravages, but he could not measure the proportion that it has taken in a marked society by technical-scientific development and how the lie threatens the politics. Hannah Arendt was a reader of Kant that lived in a time much later him, she also talked about lie in a context that gave clearly signs of its more harmful consequences.

### 3. The Factual Truth in Public Sphere According to Hannah Arendt

The public sphere scenario is currently seen with suspicion and such discredit for most of the citizens. It occurs especially due to the inappropriate postures adopted by politicians that, as Plato already emphasized, leads to political degeneration, when the politic is contrary to its own nature. In this regard, this degeneration configures itself when the politics is used to the realization of the rulers' selfishness, as a way to be favored of what is public and, therefore, becoming instrument of personal enrichment, taking over public funds and, when it is used to serve shadowy interests of a minority. Indeed, however this degeneration of the politics has been pointed by Plato in the ancient Greece, or in the eighteenth century by Kant, reporting the immoral use of the prudence by political moralists, subordinators of the law to their own particular interests, the degeneration also is present in the currently political context. Hannah Arendt, German Jewish philosopher, analyzes in her essay *Truth and Politics* (1967), present in the book *Between Past and Future*, several questions that alludes to the public sphere and relates to the truth, the untruth and the politics itself, highlighting that her analysis about those elements present a commonplace – the public space. The focus of the analysis of this topic revolves around the use of the untruth on the public-political sphere, from a currently phenomenon called fake news, in place of the factual truth itself that, according Arendt, is the truth that is involved by inherent facts and events to the history and the web of human relations.

It is essential highlight that, to Hannah Arendt, the morality is necessarily related to the act of think, in other words corresponds to “this silent dialogue of myself with myself” about any subject (Arendt, 2003, p.91). The thought is a moral precept of the unconditional way: to act morally precise, first, think. And this thought, that emerge of a reflection about any occurrence of life, has a character even more relevant when performed in the intimacy of the person himself.

As a result, the author still affirms that ethical exercise is related to the act of remember about the actions of the past, that help to build a referential to a point where is not allowed to the person making acts without first thinking in the consequences or commit the same mistakes. “If I refuse to remember, I am actually ready to do anything” (Arendt, 2003, p. 94). Therefore, stopping to think in what was done and what needs to be done is indispensable to a person who worries with moral and ethical values.

On the other hand, the politics in the view of Arendt, belongs to the collective thought sphere, that is, as Celso Lafer (2018, p. 130) your area of jurisdiction is not the pure thought of the dialogue between myself with myself, but rather a dialogue which I should reach in agreement. The dialogue is only possible in a public character space, where the use of the discourse and of the action reveals itself, therefore, as the political world. This public character of the politics refers to the relevance brought by the factual truth, that will support to this plural dialogue and, consequently, the risk that the untruth projects in the public life. In that sense if the politics, by definition, happens in the public space, in the space that Arendt calls of *between the man (in-between)*, then there is no doubt that the politics involves the use of language, that has almost nothing to do with conceptual definitions or with the expression of the immutable essence of things. The language in the politics is, especially, the expression of a point of view, the participation of a perspective, of an apprehension, always partial, of the world. What the discourse reports is the world “as it seems” to



someone, what Arendt means by approaching a Greek term: the *doxa*, namely, the opinion (PEREIRA, 2019. p. 11).

Thereby, for establishing the politics as relation, that is effective when men are together in a public space, sharing their speeches, their opinions and their actions, the author says that, differently of the rational truth – for not being subject to debates -, it is the opinion that is present in the political sphere, because the opinion is built from the exchange of points of view, of perceptions that make up the plurality of the public space, that is the fact that is not the Man, but the men who discourse and interact between them. That is the human condition of the political action itself.

Arendt asserts that traditionally the lie in political sphere was limited, because only a few people participated of the important decisions in the city and thus it was easier identify what was true and lies. According to Rosângela Chaves it is of extensive public knowledge that the secrets of State always existed, and, through the centuries, the diplomacy invariably appealed to all manner of ruse in the transactions between the nations. However, the organized lie, as instrument used by governments not as much to dupe the enemy, but to deceive the internal public, gained strength especially since the twentieth century, to the point where it seems naive the affirmation of Clemenceau in the first decades of the last century that it would be absurd any attempt to change the factual matter. The totalitarian experience, both in the Nazis version and in the Stalinist version, continues being the most traumatic example of the use of propaganda and ideology, allied to terror, with the aim of rewrite the History and suit the reality according with the convenience of who have the power. (Chaves, 2016, p. 69)

The totalitarian experience present what Arendt called organized lie or lie of mass, becoming one of the pillars of the totalitarian system because on the one hand, the organized lies stops the knowledge of the world and, consequently, make it impossible the constitution of the world itself and [...], on the other hand, the lie corresponds to the absence of the common world and inhibits the human capacity of act: without world and without true there is no action. (Pereira, 2019, p. 10). In that sense, Arendt already highlights how the ideology and the propaganda achieved increasingly the capacity of settle itself in the political sphere. We can observe that, in the contemporary era, the technological advance of the communications allowed a new form of mass manipulation in the political world, by the *fake news*, that make it easier the lies propagation and hinder the credibility of facts, that is, the factual truth:

It has frequently been noticed that *the surest long-term result of brainwashing is a peculiar kind of cynicism—an absolute refusal to believe in the truth of anything, no matter how well this truth may be established* [emphasis added]. In other words, the result of a consistent and total substitution of lies for factual truth is not that the lies will now be accepted as truth, and the truth be defamed as lies, but that the sense by *which we take our bearings in the real world* [emphasis added] — and the category of truth vs. falsehood is among the mental means to this end—is being destroyed. (Arendt, 2006, p.343).

Based on this, it is noticed that the exercise of thinking in the political world, most of the time, certainly does not aim to a sincere dialogue with the goal of achieving an agreement for the benefit of people, but rather aim for manipulation of them: the political power does not concern about acting in accordance with the correct; but, yes with what could be more advantageous to who exercised it. On the other hand, it is known that currently the means of communication have gained great prominence as for the

direct influence in the way of thinking and acting of the citizens, what could be well seen in several historical events, as the Nazism itself, that used the propaganda to strengthen its ideology of persecution, especially, to the Jews, and, recently, in the awareness of fraudulent news (*fake news*) published in social networks, that helped in the victory of the current President of the Republic of Brazil, Jair Bolsonaro. Rosângela Chaves tells that: there is no doubt yet about the primordial role of the means of communication in the building of the public opinion (although it does not mistake with the public opinion, sometimes it falls into this temptation). Therefore, the quality of the public opinion depends on the quality of the information in which it has access through the means of communication – let us remember what said Hannah Arendt: facts are not opinions (Chaves, 2016, p. 71).

The current and stable democracies by the eyes of world, seem enter in an era which reports about events lose reference in the factual truth (Bucci, 2018, p.22). The United States of America elected Donald Trump as President through his electoral campaign that had support of *fake news* which were largely shared, while the United Kingdom used deceptive advertising about the exit from the European Union. Then, we notice that the *post-truth* era prevails today, this term corresponds to arguments which flee from the truth of facts and become replaced by appeals of emotional nature that do not have commitment with reality. Therefore, the problem of post-truth is realized in face of manipulated information that aims be favorable according to the objective that someone wants to achieve, even if it is necessary use lies and untruths, this dynamics affects precisely the factual truth. Thus, this same public opinion can be exiled to the point of does not deserve anymore this name if loses the capacity of differentiate the truth from false, it becomes something like humour subjected to variations of moment, because of manipulation of facts by mass media industry when it dares to intervene on the own factual material, erasing the line between truth and lie, between fact and opinion. This kind of attack on truth can occur in the most diverse ways: with the creation of “factoids”, events and statements without context, the approach of biased and partial about a particular issue, the editorializing of news media when opinions seem disguised as unquestionable facts, the omission of facts, the sensationalism, not open for the contradictory, etc. (Chaves, 2016, p. 71)

Arendt (2006, p. 311) emphasizes that the conflict between moral and politics is quite old, as well as the struggle for power does not destroy factual truth: “the chances of factual truth surviving the onslaught of power are very slim indeed; it is always in danger of being maneuvered out the world not only for a time but, potentially, forever”. Facts and events have their own fragility, since they occur within the constant change of public space, it is different of theories or human discoveries that come from reason, so it depends of a protection for not become swept away from time. Still in the philosopher’s point of view, it is important discuss about the existent conflict between rational truth and politics, since as Chaves (2017, p. 67) says if every pretense for absolute truth has success it undermines the public space. According to Pereira (2019, p. 11) Arendt, not rarely, reported the affinity between truth and authoritarian regime since the truth is not subject to debates. Under this point of view, the truth reveals its antipolitical nature when silence the speech: its presence dismisses and is incompatible with the exchange of ideas. Hence, a charge so serious about a classic theme of the history of philosophic thought seems to undermine any attempt to address the political action under perspective of truth.

In this regard, the truth is coercive and does not allow discussion. So, we can ask to ourselves – is the truth inefficient when we talk about politics or political public space? According to Hannah Arendt, the

rational truth is apolitical, and thus inappropriate to public political sphere. As a solution of this conflict, Arendt points out to what she called factual truth. This factual truth refers to events and conjectures that involve several people that are dependents of confirmation, and for its guarantee of existence, it must be spoken in public sphere or even in particularity. The factual truth has a political nature, such as the opinion that depends on factual truth to exist, for this reason the freedom of opinion can be considered a fraud, if it does not have a questionable nature. Fact cannot become opinion since its truth is imposing, in other words, factual truth carries with it the coercion of be what is: “all truths – not only the various kinds of rational truth but also factual truth – are opposed to opinion in their *mode of asserting validity*.” (Arendt, 2006, p. 321). Therefore, the factual truth does not depend of opinion or consent to stand up for itself, since it has imperative force and, for this reason, enters in conflict with political power: its nature is tyrannical and bothers who wants to come to power and stay there.

For bringing this perspective to the Brazilian case, between October the days 26 and 29, the organization Avaaz through IDEA Big Data realized a study which showed that 90% of president Bolsonaro’s voters consider as truth fraudulent news broadcasted by social networks as Facebook and Twitter. The Organization of American States (OAS) pointed out that the use of fraudulent news to manipulate people’s opinion in elections through private networks of communication, most probably, does not have precedents. Others research coordinated by other institution highlighted that most of the untruthful news were launched against the Worker’s Party, at that time it included the candidate of the same party, Fernando Haddad.

Likewise, in October 2019 the daily newspaper *The Guardian* released an analysis about how fraudulent news that were widespread by messaging app, WhatsApp, benefited Jair Bolsonaro’s conquest of presidency in the election of 2018. *The Guardian* had access about twelve hundreds messages which were shared during election, and it concluded that right-wing generated approximately 42% of fraudulent news against only 3% produced by left-wing. The fake news were about supposed fraud in voting machine, and attacks directed to left-wing politics and activists, most of time these attacks used homophobic, antifeminist, and libelous insults. Then, considering the far-reaching of people through social networks, there is a strong indication, if not evidence, that fraudulent news contributed significantly to Jair Bolsonaro’s victory.

For Hannah Arendt, the main opposite of factual truth is not the mistake, but rather the lie. The cases narrated previously correspond to lies that are meticulously prepared which aim influence the result of elections in favor of a certain candidate. The lie in social networks, mainly regarding politics but not only, became an extremely ethical problem, since the liar believes have found a free space to adjust his “facts” as he thinks is better for the object that he seeks, he become more reliable than who say the truth. Still in the understanding of the philosopher, the main issue is not the replacement of truth for lie, but rather the ability of lie to elaborate a process of destruction of truth which turns evident the political violent politics. “All these lies, whether their authors know it or not, harbor an element of violence; organized lying always tends to destroy whatever it has decided to negate” (Arendt, 2006, p. 337). Thus, the facts, as well as untruths, are not well protect under wings of power.

Facts assert themselves by being stubborn, and their fragility is oddly combined with great resiliency—the same irreversibility that is the hallmark of all human action. In their stubbornness,

facts are superior to power; they are less transitory than power formations, which arise when men get together for a purpose but disappear as soon as the purpose is either achieved or lost. This transitory character makes power a highly unreliable instrument for achieving permanence of any kind, and, therefore, not only truth and facts are insecure in its hands but untruth and non-facts as well. The political attitude toward facts must, indeed, tread the very narrow path between the danger of taking them as the results of some necessary development which men could not prevent and about which they can therefore do nothing and the danger of denying them, of trying to manipulate them out of the world. (Arendt, 2006, p. 346)

As Eugênio Bucci well points out the issue of social networks and internet are not in the technological advancement or the ease of communication provided for individuals, but rather in social relationship and how it impacts human life in a negative way, and consequently in public sphere. The quickness that news get to users and the profit generated by fraudulent news are the main reasons why sites as Twitter, Facebook and Google help to increase the phenomenon of post-truth. The great problem, then, surrounds in the way that the society in general use these news technologies of information, it includes those who profit and who buy information both are not worried about sources and veracities.

The news currently highlights people's entertainment that provides good or bad emotions that are in continuous disengagement with facts around and ethics. Today the factual is sensationalist, far from being understood as a truth. It seems that the big business of communication and social networks do not worry as they should for the ethical practice of these actions, as they do not worry about the antidemocratic impact of proffering invalid information and how it will have a negative impact in public space. Communication practices used on social networks that are not based on careful checking or truthfulness criteria of plurality, bury and compress islands that observe the classic protocols of press. (Bucci, 2019, p. 28)

As well said previously, Hannah Arendt defends that every way of persuasion can lead to destruction of factual truth, however they cannot replace it. That is why philosophy understands as indispensable protection of institutions such as judiciary branch and universities, since both should be necessarily autonomous and independents. According to the thinker:

Very unwelcome truths have emerged from the universities, and very unwelcome judgments have been handed down from the bench time and again; and these institutions, like other refuges of truth, have remained exposed to all the dangers arising from social and political power. Yet the chances for truth to prevail in public are, of course, greatly improved by the mere existence of such places and by the organization of independent, supposedly disinterested scholars associated with them. And it can hardly be denied that, at least in constitutionally ruled countries, the political realm has recognized, even in the event of conflict, that it has a stake in the existence of men and institutions over which it has no power. (Arendt, 2006, p. 348)

It is noteworthy yet that Arendt emphasizes the important role of press in the society. Regarding the search for factual truth, it should be, necessarily, investigated out of political sphere. The reason is we should protect the freedom to reveal factual truths as they are, even if they damage power, "for this very important political function of supplying information is exercised from outside the political realm, strictly speaking; no action and no decision are, or should be, involved" (Arendt, 2006, p. 349).

From what were presented, it can infer that in the contemporary society the use of lie become explicit and regular with its most diverse ways and manifestations. In the political sphere the lie wins a new highlight even more meaningful, since is evident that it represents a danger to the current democracies, especially the Brazilian one that never being so fragile as nowadays which its leadership of the bigger state is exercised by an individual who was elected with a significant help of fake news. Assiduous Hannah Arendt's reader, Celso Lafer (2008) highlights that the factual truth is not an opinion issue. For that reason, even the democracy, which presumes the respect for citizenship and responsibility of power requires the ruled rights for exact and honest information. The ruler's word massacres, hides, and puts into question the base of democratic public life given by the factual truth. During the variation of versions, it leads to apathy, cynicism, and indifference.

In addition, fraudulent news that create lies are not only a public danger, but also a way of make money. It happens as were expected, and for this reason, should be accepted. Thus, politics is constructed from lies that are scattered in diverse mass media in an indiscriminate and without social responsibility that, in some way, are freely broadcasted for users that cannot perceive how they are manipulated in proportions ever seen before. The global society, for example, follows being quickly devoured by this new context where the lie is profit and the truth is a historic rarity almost disappearing.

#### **4. Conclusion**

Kant and Arendt, despite the difference of moments that they wrote, and, consequently, the worries that conducted their texts, seem agree about the malefic unequivocal that lie can bring to the public space. Kant is assertive when he affirms that the public use of reason should always be free, the freedom of speech, and the freedom to become thought in public is committed to the enlightenment, in other words, to the autonomy thought, thus the impossibility of rupture with authorities is typical of immaturity, it makes men who are directed by other easy prey to power-hungry manipulators that are committed to their own interests. Nevertheless, for the author, the freedom of speech does not bring with it the idea of people freely express whatever they want, thinking for oneself does not constitute a tool for dissemination of false information, but rather to lead for public space the analysis, as an example, of civil laws, and the way that ecclesial faith adheres to statutory laws, etc. The submission of themes to the public scrutiny contributes to human progress toward better, since the exercise of thinking imposes to itself the reception of maxims, and considering that our choices should take into account the question: can the maxim become universal? It reflects the responsibility that each choice leads, once each man represents humanity.

On other hand, autonomy is also a convocation of erudite public that can influence even principles of government. In this scenery, there is a category that includes fraudulent and untruthful maxims, they are unacceptable from an ethical point of view as much as legal, since the bad use of freedom promotes the deceit and distrust which put the contracts in doubt and the human own dignity in risk.

Hannah Arendt, just as the Kantian thought, emphasizes the importance in human life of thought before action. Moreover, the philosophy defends that the factual truth in public space has a significative value regarding to collectivity, it alerts that people in power will act against facts that are unfavorable to them. Distort facts and create lies in favor of political power is an old action. This reality, nevertheless,



won serious proportions with the expansion of mass media, especially with the emerge of social networks. What happens is that fraudulent information reveals itself as a great opportunity of business, in other words, they are creators of large fortunes for who monopolize the new communicational networks, with this purpose they ignore all ethical dictates which can result in impacts to public life. Beyond doubt, it is an unprecedented phenomenon that the society must confront as soon as possible, it depends on an effective control and a new ethical paradigm.

## 5. Acknowledgements

Authors thank the support of Coordination for the Improvement of Higher Education Personnel – Brazil (CAPES) – Code Finance 001, as well as the Foundation for the Support of Research and Scientific and Technological Development of Maranhão (FAPEMA) -Universal/Edital nº 02/2018.

## 6. References

- KANT, I. *An Answer to the Question: 'What is Enlightenment?'*. In: Kant: Political Writings, Han Reiss (ed.). Cambridge: Cambridge University Press, 1991.
- KANT, I. *What Does It Mean to Orient Oneself in Thinking?*. In: Religion and Rational Theology. Allen W. Wood and George Di Giovanni (eds.). Cambridge: Cambridge University Press, 2001.
- KANT, I. *Toward Perpetual Peace and Other Writings on Politics, Peace, and History*. Pauline Kleingeld (ed.). New Haven: Yale University Press, 2006.
- KANT, I. *The Conflict of the Faculties*. New York: Abaris Book, 1979.
- KANT, I. *On a Supposed to Tell Lies from Benevolent Motives*. In: Kant's Critique of Practical Reason and Other Works on the Theory of Ethics. London: Longmans, Green, and Co, 1909.
- KANT, I. *Groundwork of the Metaphysics of Morals*. Cambridge: Cambridge University Press, 1998.
- KANT, I. *Ideia de uma História Universal de um Ponto de Vista Cosmopolita*. São Paulo: Martins Fontes, 2003.
- TERRA, R.R. *Juízo Político e Prudência em À Paz Perpétua*. In: Kant no Brasil. São Paulo: Editora Escuta, 2005.
- BOBBIO, N. *Direito e Estado no Pensamento de Emanuel Kant*. São Paulo: Mandarim, 2000.
- CALORI, F. *'Laut Denken': a Transparência em Kant*. In: O Público e Suas Normas. Maria Isabel Limongi, Vinicius de Figueredo e Luiz Repa (eds.). São Paulo: Barcarolla, 2015.
- CHAVES, R. *Política e Mídia: o Conflito entre Opinião e Verdade na Obra de Hannah Arendt*. Revista Panorama, XI (1), pp. 66 -72, 2016.
- BUCCI, E. *Pós-política e Corrosão da Verdade*. Revista USP, (116), pp. 19-30, 2018.
- LAFER, C. *Sobre a mentira*. O Estado de São Paulo, July, 20, 2008. [Online]. Available: <https://www.flc.org.br/sobre-a-mentira-celso-lafer/>. [Accessed: Nov. 12, 2019].
- LAFER, C. *Hannah Arendt: Pensamento, Persuasão e Poder*. Rio de Janeiro/São Paulo: Paz e Terra 2018.



PASQUINI, P. *90% dos Eleitores de Bolsonaro Acreditam em Fake News, Diz Estudo*. Folha de São Paulo, Nov. 2, 2018. Available: <https://www1.folha.uol.com.br/poder/2018/11/90-dos-eleitores-de-bolsonaro-acreditaram-em-fake-news-diz-estudo.shtml>. [Accessed: Aug. 18, 2020].

ARENDT, H. *Truth and Politics*. In: *Between Past and Future*. New York: Penguin Books, 2006.

ARENDT, H. *Responsibility and Judgement*. New York: Schoken, 2003.

AMORIM, P. H. *Guardian Mostra como as Fakes News Elegeram Bolsonaro*. Conversa Afiada, Oct. 30, 2019. [Online]. Available: <https://www.conversaafiada.com.br/politica/guardi-mostra-como-as-fake-news-elegeram-bolsonaro>. [Accessed: Aug. 19, 2020].

AVELAR, D. *WhatsApp Fake News during Brazil Election 'Favoured Bolsonaro'*, The Guardian, Oct. 30, 2019. [Online]. Available: <https://www.theguardian.com/world/2019/oct/30/whatsapp-fake-news-brazil-election-favoured-jair-bolsonaro-analysis-suggests>. [Accessed: Aug. 19, 2020].

# **Artistic Occupations in the Historical Center of São Luís (Maranhão): implications for the preservation and valorization of the cultural heritage of Maranhão**

**PhD. Conceição de Maria Belfort de Carvalho**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.

ORCID: <https://orcid.org/0000-0002-6234-527X>

Email: [cbelfort@globo.com](mailto:cbelfort@globo.com)

**Msc. Donny Wallesson dos Santos**

Programa de Pós-Graduação em Políticas Públicas (PGPP),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.

ORCID: <https://orcid.org/0000-0001-6556-4251>

Email: [dws87@outlook.com](mailto:dws87@outlook.com)

**Msc. Maurício José Moraes Costa (Corresponding author)**

Centro Universitário UNDB  
São Luís, Maranhão, Brazil.

ORCID: <https://orcid.org/0000-0002-0759-9285>

Email: [mauriciojosemoraes@gmail.com](mailto:mauriciojosemoraes@gmail.com)

**PhD. Kláutenys Dellene Guedes Cutrim**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.

ORCID: <https://orcid.org/0000-0002-8668-4188>

Email: [kdguedes@gmail.com](mailto:kdguedes@gmail.com)

**PhD. Arkley Marques Bandeira**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.

ORCID: <https://orcid.org/0000-0002-7646-7526>

Email: [arkleymbandeira@gmail.com](mailto:arkleymbandeira@gmail.com)

**Msc. Vanderley Rabelo de Jesus**

Programa de Pós-Graduação em Cultura e Sociedade (PGCULT),  
Universidade Federal do Maranhão,  
São Luís, Maranhão, Brazil.

ORCID: <https://orcid.org/0000-0001-7955-1638>

Email: [vanderleydejesus21@gmail.com](mailto:vanderleydejesus21@gmail.com)

## **Abstract**

*Study about the implications of artistic occupations in the Historic Center of São Luís for the preservation and valorization of the cultural heritage in the State of Maranhão. It aims to discuss the implications of artistic occupations present in the Historic Center and how they can contribute to the revitalization, preservation, and valorization of the cultural heritage of the capital. It is an exploratory and descriptive study, which uses documentary research and bibliographic research as a reasoning mechanism. It addresses artistic occupations and cultural heritage in its theoretical-conceptual perspectives. It also discusses the implications of artistic occupations in the Historic Center of São Luís, and how they contribute to the preservation and valorization of the cultural heritage of Maranhão. It characterizes the Old Center of São Luís, the role of artistic occupations and its implications for the cultural heritage of São Luís. And it points out that artistic occupations permeate time and space, bringing resignifications and enabling the dynamic permanence of the idea that cultural heritage is not limited to ruins, inexorable monumental mansions or untouchable works and documents.*

**Keywords:** Artistic Occupations; Historic Center of São Luís; Cultural Heritage; History and Memory.

## **1. Introduction**

The city of São Luís, as well as other historical Brazilian cities, carries the marks of a long period of Portuguese colonization, whose effects can be seen in its architectural arrangements, located mostly in its historic center. Such architectural arrangements were responsible not only for portraying an entire historical legacy, but were also decisive for the city to earn the title of World Heritage, granted by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1997 (Silva, 2017).

The Historic Center of São Luís (HCSL) is known nationally for having one of the largest civilian architectural ensembles with traces of European origin and stands out as one of the main postcards of the city. Despite being part of the history of the capital, the abandonment of the place is visible. Some initiatives were taken by the government in order to revitalize this space; one of them was the development of a policy of occupation by artistic collectives.

Being one of the main exponents, both of the State of Maranhão and of Brazil in terms of heritage, the HCSL has been the object of study in many different fields of knowledge. Investigate its nuances is essential not only to make assets located there more evident, but also to make known the actions that favor the preservation and the valorization of this space that, over time, became relevant not only for its architectural heritage, but as well for its cultural wealth. Considering this, the present study has the overall

objective of discussing the implications of artistic occupations present in HCSL and highlighting how these can contribute not only to its revitalization, but also to the preservation and valorization of the cultural heritage of the capital of Maranhão.

In this perspective, it is an exploratory and descriptive study, which uses documentary research as instruments of theoretical foundation, since it uses documents, images, materials, which portray collectives of artists and other artistic occupations. In addition, the investigation uses bibliographic research as a mechanism to dialogue with authors that address the themes of Cultural Heritage and Artistic Occupations. Among them, Choay (2006), Garcia (2017), Paiva and Gabbay (2016), Medeiros (2002), Fonseca (2009). The research used materials from databases and digital repositories, such as the Brazilian Library of Theses and Dissertations (BDTD), Scielo, Google Scholar, whose searches used the following descriptors: a) Artistic Occupations; b) Equity; c) Cultural Heritage; d) Social Movements; e) Memory. The productions were analyzed qualitatively, through technical reading, with the perspective of identifying the pertinence with the investigated theme.

## **2 Artistic Occupations and Public Space: brief considerations**

History shows, over time, the symbolic construction of spaces in the city to become the stage of popular participation in decisions of public interest in an attempt to equate the power between state and civil society, since ancient times, with the decision-making arenas of ancient Greece, until the current popular uprisings, with the occupation of squares and streets. In this sense, the perception of the public space permeates both the urban aspect - non-private locations, of universal and free use by the population - to those places of decision-making for public interests, such as buildings and institutional areas of the government (Sartori; Garcia, 2013).

The countless ways in which an individual can relate to the city are receiving attention from researchers. In the mid-twentieth century, there was a considerable interest in analyzing the social processes characteristic of certain urban spaces. Studies such as those of Walter Benjamin, Georg Simmel, Max Weber and Guy Debord – the latter a pioneer when it came to problematizing everyday life – are gaining important visibility, in order to break their logic, which is alienated by capital (Conceição, 2013). Conceição (2011) notes that there is a peculiar complexity in the relationship of people with the city and with the spaces that are established in it, which results directly from the enjoyment of historical, political, economic, social and individual transformations. Amplifying what Conceição (2011) has observed, Paiva and Gabbay (2016, p. 4, ) say that “ [...] the city as a psychic space, thanks to the production of a chain of affections collectively sustained [...] (Our translation)” in the public space, seen as place of democracy, relationships are established between individuals of common production: spaces for exchanges, contacts, dialogues and affections.

In this perspective of the public space as a place of democracy, Sartori and Garcia (2013) ratify the rich complexity of exploring the relationships that belong to it, characterizing it as a space for the formation and discussion of the public agenda, negotiated by the effective participation of civil society in its elaboration. But they also point out that the prevalence of private interests over the public interest in the use of city spaces, that is, the elites (bourgeoisie and state) hold the power to use the spaces to the detriment

of the needs and rights of the population to enjoy them. Corroborating this idea, Paiva and Gabbay (2016) found a causal relationship between the occupation of public spaces and the privatization of cities. Developing countries, like Brazil, adopt a North Americanized urbanization model that imposes itself on the population: a global city full of shopping centers, malls, and large buildings, in a state of continuous surveillance and asepsis.

This phenomenon is called gentrification. The term was coined by the British sociologist Ruth Glass, in the 1960s, and refers to the real estate and social group transformations in certain districts of London, United Kingdom, of that period. The concept continues to be used to describe processes of transformation of the urban space in which certain regions with specific characteristics - especially industrial areas, workers, ports and historic centers - face processes of land rehabilitation and valorization (Garcia, 2017). Sociologist Rogério Proença de Sousa Leite (2001) states that the term is used to designate the transformation of cultural spaces, which carry a heritage legacy, into products that will feed the market flow, mainly from tourism, and direct cultural policies to look at cultural goods only as merchandise. The gentrification phenomenon is shown as an important bias in the understanding of these relationships. Its concept runs through the requalification of public spaces for the democratization of culture when in fact it is creating barriers for the local population to enjoy cultural public goods, through the overvaluation of the image of the space with new buildings, renovation of squares and public cultural facilities that attract a portion of the population with greater financial capital.

As a result of this problematization, the emergence of civil society in Brazil, in the 1980s, built spaces for debates and democratization. Sartori and Garcia (2013) point out the neoliberalism of the following decade as causing, in a large part of the population, a feeling of “non-belonging” to society, due to the socioeconomic imbalances, constituted by a picture of extreme poverty and reduction of popular participation spaces, making it essential “[...] the consolidation of public spaces that advocate the universalization of social rights through their recognition and representativeness within the scope of civil society. (Our translation)” (Sartori; Garcia, 2013, p. 8).

Amid governmental instabilities of change of power, artistic occupations remain alive and active, as their common production, carried out by civil society, goes beyond the systematic and mechanical idea of artistic practice as a rational and conscious product, made by public policy, in an impetus of struggle and resistance for its maintenance (Paiva; Gabbay, 2016). Entering the artistic perception of the use of public spaces, the practices of artistic making on the street inevitably create bonds between the body of the individual and the urban body, creating visible and invisible connections between everyone who participates in the action. This way of appropriating the space, creating social bonds, goes against the spatial relations arising from the metropolization, in which being and sharing with the other disappears and the radical transformations in traditions practiced by the local community (Moreaux, 2013).

Such collectives of people that emerge in cities identify and legitimize their real problems and propose ways to solve them, something that was once common in small cities today is necessary in large cities, in a real need to reorganize the city and its public spaces (Duran, 2008). Thus, Garcia (2017) points out about new socio-spatial configurations of culture and city that such resignifications of the public space occur because there is a collective identity surpassed in symbolic values of expansion of the characteristics common to residents and users of that space through the construction of signs of well-being and satisfaction.

To speak about the art occupations requires also to talk about heritage. After all, the idea of heritage is built on a relationship that involves artistic and cultural goods.

### **3 Cultural heritage: from definitions to recognition**

To think the Cultural Heritage and what it represents leads us to the need to remember - even if only briefly - its constitution and conceptualization. Beforehand, it begins, by looking in the lexicon of the word for a first attempt to establish a concept. Vogt (2008) emphasizes that Patrimony has its origin in Latin *patrimonium*, which means paternal inheritance, or that which integrates the *parter*, that is, the father.

Silva (2017) complements, emphasizing that, in the context of the Portuguese language, the term “patrimônio” is defined as that which is inherited from parents – family assets. In this sense, Choay (2006) highlights that the concept of heritage is related to family structures, however, over time it also had other meanings, adding genetic, historical and cultural aspects. Relating itself as different aspects, not only from a patriarchal perspective, but closely associated with a monument, this to the detriment of the influence of Architecture, Visual Arts, Anthropology and History (Pereira, 2017), the focus is on the genesis of what is meant by “patrimony” started in the 18th century, this considering that in Antiquity Classical and in the Medieval Age the term also had great notoriety (Choay, 2006).

The concept of a monument provided reflexive conditions so that the concept of heritage itself could be outlined. Reigl (2014) points out that monuments have always had values and meanings, something that was accentuated in the middle of the 15th century, just when the perspective of memory was transformed through the appreciation that enshrined the historical and artistic value of ancient monuments. Alois Reigl's contributed significantly to the reflections on heritage in the 20th century, which even influenced Françoise Choay in his studies on the theme.

The change in the concept of a monument, which from archaeological value came to represent the testimony of past centuries, gave way to the concept of historical monument (Pereira, 2017; Choay, 2006). In this sense, Pereira (2017) points out that with the advent of the nation state, historical monuments started to represent the assets of a nation. Fonseca (2009) and Pereira (2017) dialogue through their studies, emphasizing that, in the middle of the 18th century, the State's actions were scarce, with a view to the preservation of historical monuments, which gave precedent for their destruction. According to Fonseca (2009), aiming at the maintenance of historical monuments, in France the position of Inspector of Historical Monuments was created and, later, the Commission of Historical Monuments with the intention of combating the depredation of the property of the time.

According to Rocha (2018), the historical construction of the meaning of heritage has expanded and changed, leaving only the historical monuments, but highlighting elements such as language, rhythms, tastes, and flavors. Therefore, it stands out that “Cultural heritage is a symbolic construction process that has dimensions such as sociocultural, natural, technical, political, and economic. (Our translation)” (Fernandes, 2017, p. 32).

In addition, it should be noted that “Heritage is currently used for a wide range of activities. In the cultural sphere, it was incorporated due to its artistic and handcrafted productivity, in addition to the vision that considers artifacts and intangible assets as worthy of preservation. (Our translation)” (Silva, 2017, p. 16).



Such elements are important exponents for the consolidation of the understanding of heritage and what it represents, not being restricted only to architectural constructions.

The preservation of heritage emerges in the need for spaces capable of preserving and safeguarding memory. Memory is also placed as an important category related to heritage. In this sense, heritage stands out as a political-institutional mechanism that reinforces the importance of heritage as an entity responsible for the public memory of a people. Thus, according to Funari and Pelegrini (2009), patrimonialization consists in legitimizing a public good, which in turn must be preserved.

It is known that among the institutions responsible for the representation, appreciation and preservation of cultural heritage is UNESCO, responsible for chancelling a patrimonial asset as a Cultural Heritage of Humanity (Figueira, 2016). According to Gonçalves (1996), adding cultural heritages in the official listing of protected cultural properties is the legal mechanism, in which these cultural assets are officially recognized as heritage. In the author's words, "Putting them in the list is, therefore, the declaratory act of incorporating a good into the national historical and artistic heritage." (Gonçalves, 1996, p. 66). Adding them to list of protected cultural properties is the method by which the State appropriates cultural assets, which in turn are part of the national heritage.

Choay (2009, p. 222) points out that the recognition process takes into account aspects such as "[...] valorization of architectural heritage in general and, in particular, its reuse or, in other words, its integration in contemporary life [ ...] (Our translation)." Figueira (2016) states that historic cities occupy a central place among the goods recognized internationally as heritage. With such recognition, urban arrangements, neighborhoods, as well as the city receive a "seal" of heritage protection endorsed by UNESCO, in which its elements contextualize and represent significant stages in the history of humanity (Norrild, 2002; Figueira, 2016).

The Historic Center of São Luís is part of the city's heritage and in recent years it has been a space for diverse activities, among them the Book Fair, festivals of alternative and popular Brazilian music, interventions, and artistic occupations. Such practices not only resignify, but give a new perspective to this space loaded with memory and symbols of the culture of Maranhão. In the following section, we discuss how such practices, especially artistic occupations, affect citizenship actions, preservation, and enhancement of the State's public heritage.

## **4 Artistic Occupations and their implications for valuing the Cultural Heritage of São Luís (Maranhão)**

The Historic Center of São Luís is internationally known for its beauty and for being an area of great historical and cultural value, as well as architectural and landscape value (Cutrim; Costa; Oliveira, 2017). The central region of the capital of Maranhão had its appearance associated with the main economic locus, the port, and its coastal region. The region of Praia Grande was the big commercial hub of the early days of the colonization of São Luís, becoming the loading and unloading point of the marketing flow of import and export, constituting, the genesis of the city and its society.

Since the center of São Luís resulted from human actions, overlapping for different periods of time, and considering the advancement of trade and relations business established in Praia Grande, its historical and

cultural value was consolidated, and today it is considered one of the important spaces in the capital of Maranhão (Noronha, 2015). The Historic Center of São Luís has an extension of approximately 220 ha, comprising the neighborhoods of Praia Grande, Desterro, Apicum, Codozinho, Lira, Belira, Macaúba, Coreia and Madre Deus, as it can be seen in Figure 1:

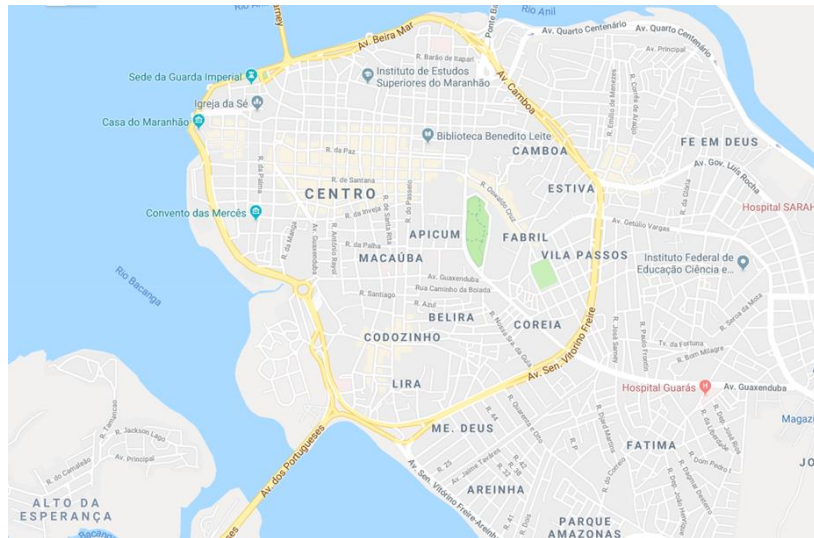


Figure 1. Map of the center of São Luís, Maranhão

Founded by the French around 1612, the Historic Center had then its core established. After the Battle of Guaxenduba, the Portuguese, then led by Jerônimo de Albuquerque, brought to São Luís in 1615 the engineer Francisco Frias de Mesquita, responsible for planning all that space (Mendes; Sousa, Marques, 2016). The urban plan of São Luís presented the same architectural models of other historic cities, such as Rio de Janeiro and Recife (Costa, 2017; Mendes; Sousa; Marques, 2016). In mid-1641, São Luís was then taken by the Dutch, led by Maurício de Nassau. It is noteworthy that in this period some churches have been damaged, such as the Desterro Church and the Church of São João Batista, the latter only recovered about twenty years after the expulsion of the Dutch, in 1644, in a movement led by Teixeira de Melo (Branco et al., 2017; Mendes; Sousa; Marques, 2016).

Although São Luís had a trade widely developed for the time, it also stood out because of its great names and literary productions. According to Braga (2013) and Silva (2009a), the 19th century brought with it important advances, among them the expansion of typography and the rise of print in the State of Maranhão. In this statement, it is emphasized that the capital of Maranhão gained prominence, both for its intellectuals and for its architectural arrangement, which maintained the colonial features, evidencing the period of great commercial and economic success, represented by the tiles that predominated in its facades.

Therefore, we can say that the Historical Center of São Luís “[...] portrays the homogeneous ensembles from the eighteenth and nineteenth centuries represented by the two-story façades covered in Portuguese tiles [...]” (Mendes; Sousa; Marques, 2016, p. 4). The Historic Center of São Luís presents a unique architectural ensemble, which expresses all the economic power of the capital in the colonial period, especially due to the abundance of Portuguese tiles. São Luís was considered one of the most prosperous cities in the country, thanks to the large production of cotton, rice, among other things (Silva, 2009a).

Although it expressed the apogee of the capital of Maranhão in the colonial period, the Historic Center, from the 20th century onwards, was being abandoned. This was due to the departure of the older residents, who were occupying other more noble spaces in the city, and also by the drop in trade in the place, causing a “[...] process of ruining various buildings in the urban fabric of that area [...] (Our translation)” (Silva, 2009a, p. 2).

It is noteworthy that in the 1940s there already those interested to put into effect the prerogatives of the Decree-Law 25/1937, whose aim was to protect the heritage assets of great value to the country. With this, the fight to protect the architectural complex of center of São Luís gains enthusiasm. According to Andrès (1998, 104 p.), Maranhão gave an important step, by "adding the Sambaqui do Pindahy in the official listing of protected properties with the Process 211-T-39; Inscription nº 6, Archaeological, Ethnographic and Landscape Book, pages. 02, 19/01/1940 [...]”, it was the first addition to the list of federally protected properties in the state (Silva, 2009a). According to Silva (2009a), the addition of the Chapel São José da Quinta das Laranjeiras to this in the book of Fine Arts, in April 1940, was also another milestone in Maranhão. In addition, the author highlights the inclusion of Fountain of Ribeirão in 1950 and the Cathedral Church of Nossa Senhora da Vitória in 1954 in the same book, in other words, the State already had some previously listed spaces (Wall; Braga, 2014; Silva, 2009a ).

It is noted that other actions to add more properties to the list were carried out, which are fundamental for the Historic Center of São Luís to acquire even more value, above all due to its architectural arrangement. The actions aimed at preserving the patrimonial assets of Maranhão, especially those located in São Luís, were consolidated in 1974 by the Service for the Protection of Historical and Artistic Heritage (SPHAN) (Cutrim; Costa; Oliveira, 2017).

Consolidating itself as a moment of great importance not only for Maranhão, but for Brazil, the Historic Center of São Luís was born, thanks to the actions of the National Historic and Artistic Heritage Institute (IPHAN). According to Cutrim, Costa and Oliveira (2017), the Historic Center concentrated the main preservation activities, since it brought together a grandiose architectural set and “[...] because it is a living historic city, due to its very nature of capital that, despite its expansion, continued to preserve the 17th century urban fabric and its original architectural ensemble.” (Mendes; Sousa; Marques, 2016, p. 4-5).

After the national recognition of the architectural ensemble of center of São Luís, on December 6, 1997, the Historic Center was internationally recognized by the United Nations Educational, Scientific and Cultural Organization (UNESCO), receiving, beyond the addition to the list of protected properties, the title of Cultural Heritage of Humanity (Silva, 2017; Mendes; Sousa; Marques, 2016).

The Historic Center of São Luís, in recent years has been a space for diversified activities, among them the Book Fair, festivals of alternative and popular Brazilian music, interventions and artistic occupations. Such practices not only give new meaning, but also give a new perspective to this space loaded with memory and symbols of the culture of Maranhão. In the following section, we discuss how such practices, especially artistic occupations, affect citizenship actions, preservation, and enhancement of the State's public heritage.

#### ***4.2 Artistic occupations and their implications for the cultural heritage of São Luís***

Although the movements of artistic occupation in the Historic Center of São Luís are of long-standing (see about the 30 years of the Collective *A Vida é uma Festa*), it was through the extinction of the Ministry of

Culture, in May 2016, by the interim government of Michel Temer, that the term occupation gains a greater significance through the struggle and resistance on the part of the local artistic class, by the movement called *OcupaMinc-MA*, being São Luís, one of the pioneer capitals in the occupation of IPHAN buildings throughout Brazil, under the allegation of illegitimacy of the government and loss of basic social rights. Since then, in the artistic milieu of collectives operating in the historic center of the capital of Maranhão – even though they already had the characteristics of occupations – became part of the discourse and the slogan of the actions, and in a more incisive way, the format of occupation of public spaces as a mechanism of the civil society for the maintenance and guarantee of public, free and community cultural activities. Duran (2008) sees these collectives as legitimate representatives of the most diverse categories of society, who occupy public spaces not only with the intention of using them for entertainment and leisure only, but identify the problems there and find collective ways to solve them, in opposition to the culture of spectacles of the governments that create trained and listless audiences, consumers of a ready narrative that does not problematize the space in which it is inserted.

Regarding public cultural policies aimed at the format of artistic occupation, it is already common to see notices of promotion for occupation and public cultural equipment, such as cultural centers, theaters, rooms, among others. In 2012, in Rio de Janeiro, the *Lei do Artista de Rua* (Law of the Street Artist) No. 5,429/2012) enters into force, which allows great freedom for occasional presentations in public spaces. Another action taken at the federal level was the *Programa Cultura Viva*, created in 2004 by the then Ministry for Culture, Gilberto Gil, and made effective in 2014, which encouraged the creation of the project *Pontos e Pontões de Cultura*, which aimed to decentralize the artistic practice throughout the rural towns of the country (Menezes, 2017).

Specifically in São Luís, there were two actions that came close to fostering the artistic practice in the form of occupations: the Public Notice Pontos de Cultura, carried out by the City Hall through the Municipal Secretariat for Culture, in 2016, and 04 others public notices of occupation at specific points in the Historic Center of the city, in 2017. It is important to observe that both actions were mainly aimed at popular culture groups and collectives (Maranhão, 2017; Brasil, 2015). In view of the non-continuity of public policies in the period of change of government– something that does not happen only in Maranhão, but in the whole country – there is always a deficit of affirmative actions in force in the field of culture, especially those aimed to the format of artistic occupations .

It is in this scenario of incipient fostering actions and instabilities in maintaining cultural policies that some occupations keep working in the Historic Center of São Luís. To better clarify the discussion, two occupations with different characteristics of spaces, artistic segments and forms were taken as examples of occupation and length of trajectory, in order to relate them to aspects of heritage preservation and appreciation. The first of these is *A Vida é a Festa* (Life is a party) which, in short, is a meeting of former musicians who frequent the historic center of São Luís on an open stage of improvisations and musical shows. Their actions take place every Thursday night at Praia Grande, for the last 30 years. The program occupies the street *Ladeira do Comércio*, at the back of the Odylo Costa Filho Creativity Center, with a wooden platform, speakers, microphones and some musical instruments, building a clear invitation for anyone to participate on the open stage.

Coordinated by Zé Maria Medeiros, a singer and composer from Maranhão, the meeting is filled with several songs and sounds from local popular culture, added to the traditional *Tambor de Crioula* and musical shows, sometimes improvised, sometimes with local groups – which are invited. It is possible to observe that the flagship of the collective actions is the maintenance of the traditions of the popular culture of Maranhão, with instruments typical of the traditional rhythms of Maranhão, such as *zabumbas* and *pandeirões* of the *Bumba-meu-boi* and the *tambor grande* or *rufador*, *meião* or *socador* and *crivador* or *perenga*, which form the pairing of the *Tambor de Crioula*, among others.

In turn, the collective *O Circo Tá na Rua* (The circus is in the street), occupies the square Nauro Machado, located on street Estrela next to the João do Vale Theater, with free and public circus training. Unlike the first, this occupation has existed for five years and brings to the public space a proposal for formative action, given that many of the collective's direct collaborators began their career as circus artists with the practice developed at the meetings. Just as the previous occupation, the group offers various materials of the circus universe for people to experience and learn, such as stilts, many juggling acts, a tatami area for floor acrobatics and the allusion to traditional tightrope and strings through the slackline, a practice of balancing the strip while walking on a tensioned strip.

In this the management is collaborative. The coordination of actions is not centered on a single person. The collective's organizational structure occurs through direct collaborators, who participate in the actions in addition to weekly training, and indirect collaborators, who are all those who attend training regularly and thus collaborate to maintain the collective. It is worth mentioning that the group's network performance with other socio-cultural collectives from different districts of the island as a strategy to strengthen the occupation of public spaces.

In both occupations, we can observed that the main collaboration with the preservation and valorization of the Historic Center of São Luís as a cultural heritage is the presence of the people in the heritage space. As stated by Gonçalves (1996, p. 97, with the emphasis added by ourselves) , when analyzing the speech of SPHAN director , Rodrigo Melo de Franco Andrade, who held the position in 1937 and remained until the end of the sixties, “ [.. .] the main factor in the disappearance of the national historical and artistic heritage is the *indifference of the population* [...] (Our translation) ”, which overcomes the distinctions of social classes and is linked to the loss of Brazilian cultural identity.

In other words, with the excessive consumption of foreign cultural capital, the result of the European cultural heritage, together with the technological import and mass cultural production, requires that the people close ties with its financial materiality for the survival of an independent cultural identity. In addition to knowing the allegories, tales, and stories that build the patrimonial imagery of São Luís, we need the materiality of the concrete space to accomplish this identity construction. In this perspective, regarding the use of heritage, Canclini (1997, p. 194) observes that “[...] the goods gathered in history by each society do not really belong to everyone, even if they formally appear to belong to everyone and are available for everyone to use them [...] (Our translation)”, pointing out a clear distance between what is contained in the law and in the practical reality.

Leite (2001) criticizes the logic of the tourism industry about the assets to be preserved, since it alienates their historical meanings for the local population from the selection of those with monumental characteristics that have potential financial return, building a political orientation that minimizes, or even



neglects, the participation of the community and its constituent citizens. The author states that the revitalization policies of historic centers, in order to raise funds through the use of heritage, engender economic enterprises converging consumption to the ideas of tradition and preservation of the past, “[...] which often transforms these centers in 'enclaves' for the leisure, tourism and cultural consumption of a new middle class [...] (Our translation)” (Leite, 2001, p. 6).

It is possible to observe that artistic occupations demand the preservation and patrimonial valorization through their use, by bringing people closer to the cultural assets that make up the history of the place and the nation. The gap produced both by the laws and by the commodification of the cultural capital fades away at the moment in which the population takes on the spaces and from them develops actions directed to the social welfare with a view to revitalize underutilized public spaces and, in fact, contribute to the democratization of culture.

## 5 Final Considerations

Since the first attempts to establish a concept for patrimony, it was seen that it was related to different concepts, representing aspects that permeate from the notion of parentage, monuments, as well as identifying features, among other elements. We understand that that, even with different terminologies - material, immaterial, cultural heritage, etc. - these converge in the different dimensions that heritage contemplates. All the elements that constitute the perception of heritage are nothing more than heritage assets, regardless of their typology or classification, they must be preserved and kept alive, as they portray the memory, identity, history, knowledge and actions of a people, therefore, they must reach the next generations. Thus, it is clear that the conceptions of heritage will be reframed over the years, reflecting the different realities demarcated in time and space.

The researches found regarding the preservation and revitalization of the Historic Center of São Luís talk mostly about the architectural issue of Material Heritage and others are related to the Intangible Heritage of traditional segments of popular culture such as *Tambor de Crioula* and *Capoeira*. Against this solidification, the idea of heritage as a contemplation of the past and traditions, the occupations are anchored in the currents that understand it as a set of collective goods, belonging to the collective memory of those who live there and build their identity in the everyday of the relationships established with that heritage space, as well as in the production of new cultural goods.

Thus, artistic occupations permeate time and space, bringing new meanings and enabling the dynamic permanence of the idea that cultural heritage is not limited to ruins, inexorable monumental houses or untouchable works and documents. Moving away from the hegemonic conceptions of national identity and the overvaluation of the traditional, they bring to the public space new possibilities for thinking and problematizing heritage preservation policies that, in addition to preserving history, are there to allow the people to recognize themselves as part of it and that they can actively participate in its valorization and (re) construction.

## 6. References

A. A. Branco et al. “Bumba meu Guia: um aplicativo mobile para guia turístico do Centro Histórico de São



- Luís – MA: as igrejas do período colonial de São Luís como atrações turísticas”. *Acta Brazilian Science*, São Luís, ano 5, v. 1, 2 tri., abr. 2017.
- A. E. A. Medeiros. “Materialidade e imaterialidade criadoras: o Global, o Nacional e o Local na construção do Patrimônio Cultural – O Bairro do Recife como caso”. Tese (Doutorado em Sociologia) – Universidade de Brasília, Brasília, 2002.
- A. M. V. Fernandes. “Patrimônio Cultural, Turismo e a renovação das cidades: aproximações e dissonâncias entre Barcelona e Rio de Janeiro”. 2017. 410 f. Tese (Doutorado em Geografia) – Universidade Estadual de Campinas, Campinas, SP, 2017.
- Brasil. “O que é a Política Nacional de Cultura Viva - PNCV?”. Brasília, DF, Ministério da Cultura, 2015.
- C. G. Garcia. “Cultura e Cidade: novas configurações socioespaciais na era pós-industrial”. São Paulo, 2017.
- E. Sartori; C. H. M. Garcia. “Políticas Públicas e Espaço Público: aproximações teóricas-conceituais no contexto brasileiro”. Ensaio: Encontro Internacional - participação, democracia e políticas públicas: aproximando agendas e agentes. UNESP, Araraquara, 2013.
- F. Choay. “A alegoria do patrimônio”. Tradução de Luciano Vieira Machado. 4. ed. São Paulo: Estação Liberdade, UNESP, 2009.
- J. N. Mendes; I. B. B. Sousa; A. R. Marques. “A importância da preservação do Centro Histórico de São Luís do Maranhão como Patrimônio Cultural da Humanidade”. São Luís, EDUFMA, 2016.
- J. Norrild. “Patrimonio: características y uso”. In: R. G. Schluter; J. A. Norrild. “Turismo y patrimonio em el siglo XXI”. Buenos Aires, Centro de Investigaciones y Estudios Turísticos, 2002.
- J. R. C. Silva. “O processo de patrimonialização do centro antigo de São Luís: práticas patrimoniais desenvolvidas pelo poder público”. Fortaleza, ANPUH, 2009a.
- J. R. C. Silva. “Políticas Públicas no Centro Histórico de São Luís: as etapas do processo de intervenções urbanísticas.” São Luís, EDUFMA, 2009b.
- J. R. S. Gonçalves. “A Retórica da Perda: os discursos do patrimônio cultural no Brasil”. Rio de Janeiro, Editora UFRJ; IPHAN, 1996.
- K. D. G. Cutrim; S. R. da Costa; W. A. Oliveira. “Valorização do Centro Histórico de São Luís – MA e novas maneiras de consumo da música: um olhar sobre o festival BR 135”. *RICS*, v. 3, n. esp., jul./dez. 2017.
- L. P. de C. C. Andrès (Coord.). “Centro Histórico de São Luís-MA: Patrimônio mundial”. São Paulo, Audichomo, 1998.
- M. C. Figueira. “O espetáculo turístico do Patrimônio Cultural da Humanidade: preservar para atrair os consumidores do passado”. 2016. 257 f. Tese (Doutorado em Memória Social e Patrimônio Cultural) – Universidade Federal de Pelotas, Pelotas, RS, 2016.
- M. C. L. Fonseca. Para além da pedra e cal: por uma concepção ampla de patrimônio cultural, In: R. Abreu; M. Chagas. “Memória e patrimônio: ensaios contemporâneos”. Rio de Janeiro: Lamparina, 2009. pp. 59-79
- M. de F. A. Braga. “Biblioteca pública Benedito Leite, um campo para a ilustração e para enriquecer a alma”. Florianópolis, SC, FEBAB, 2013.
- M. Menezes. “São Luís lança edital para criação de novos Pontos de Cultura”. Brasília, Ministério da

Cultura, 2017.

M. P. Moreaux. “Expressões e impressões do corpo no espaço urbano: estudo das práticas de artes de rua como rupturas dos ritmos do cotidiano da cidade”. 2013. 175 f. Dissertação (Mestrado em Geografia) – Pontifícia Universidade Católica do Rio de Janeiro, Rio de Janeiro, 2013.

M. V. C. Conceição. “Henri Lefebvre e a Internacional Situacionista: o debate sobre a Comuna de Paris no contexto do maio de 1968”. São Paulo, ANPUH, 2011.

Maranhão. “Governo do Maranhão lança editais de ocupação artística”. São Luís, 2017.

N. G. Canclini. “Culturas Híbridas”. São Paulo, Edusp, 1997.

O. P. Vogt. “Patrimônio cultural: um conceito em construção”. MÉTIS: história & cultura, v. 7, n. 13, p. 13-31, jan./jun. 2008.

P. P. Funari; S. C. A. Pelegrini. “Patrimônio histórico e cultural: passo a Passo”. Rio de Janeiro, Jorge Zahar, 2009.

R. H. T. Silva. “Patrimônio cultural: construção do passado e do futuro em São Cristóvão (SE)”. Revista Geografia e Pesquisa, Ourinhos, v. 11, n. 1, p. 13-20, 2017.

R. Noronha. “No coração da Praia Grande”. São Luís, EdUFMA, 2015.

R. P. Rocha. “Patrimônio cultural imaterial de Itaituba/Pará.” 2018. 168 f. Dissertação (Mestrado em História) – Pontifícia Universidade Católica de Goiás, Goiânia, 2018.

R. P. S. Leite. “Espaço Público e política dos lugares: uso do patrimônio cultural na reinvenção contemporânea do Recife Antigo”. Tese de Doutorado apresentada à Universidade de Campinas, São Paulo, 2001.

R. Paiva; M. Gabbay. “Cidade, Afeto e Ocupações: ou a transfiguração do espaço público no Brasil contemporâneo”. São Paulo, 2016.

V. C. Pereira. “O tombamento da caixa d’água da Ceilândia no contexto da Política de Patrimônio do Distrito Federal.” 2017. 119 f. Dissertação (Mestrado em Ciência da Informação) - Faculdade de Ciência da Informação, Universidade de Brasília, Brasília, 2017.

V. D. F. C. Costa. “A invenção do centro histórico de São Luís/MA: sentidos de um lugar de memória”. 2017. 113 f. Dissertação (Bacharelado em Ciências Sociais) – Universidade de Brasília, Brasília, 2017.

## **Acknowledgment**

Publication funded by the financial aid for CAPES financing research (Finance code 001) according to CAPES Ordinance 206. In accordance with Internal Call No. 01/2020 of the Graduate Program in Culture and Society of the Federal University of Maranhão (PPGCult / UFMA), regarding Payment of Financial Aid to the Researcher of the Graduate Program in Culture and Society (PPGCult) from the Federal University of Maranhão.

# **Evaluation of the quality of wood from naturally fallen tree for the development of products in Design**

**Jéssica Ester Elvas Costa (Corresponding author)**

Universidade Federal do Amazonas - UFAM, Manaus, Amazonas, Brasil.

ORCID: <https://orcid.org/0000-0002-6628-3694>

Email: [jessicaester@outlook.com.br](mailto:jessicaester@outlook.com.br)

**Claudete Catanhede do Nascimento**

Instituto Nacional de Pesquisas da Amazônia - INPA/COTI, Manaus, Amazonas, Brasil.

ORCID: <https://orcid.org/0000-0001-7048-3720>

Email: [catanhed@inpa.gov.br](mailto:catanhed@inpa.gov.br)

**Roberto Daniel de Araújo**

Instituto Nacional de Pesquisas da Amazônia - INPA, Manaus, Amazonas, Brasil.

ORCID: <https://orcid.org/0000-0002-9653-305X>

Email: [rdaniel@inpa.gov.br](mailto:rdaniel@inpa.gov.br)

**Karla Mazarelo Maciel Pacheco**

Universidade Federal do Amazonas - UFAM, Manaus, Amazonas, Brasil.

ORCID: <https://orcid.org/0000-0002-9179-8518>

Email: [karlamazarelo@hotmail.com](mailto:karlamazarelo@hotmail.com)

## **Abstract**

*The sustainable use of forest resources in the Amazon is one of the precautions attributed to Conservation Units of sustainable use, and among them, the RESEX Auati-Paraná stands out in this study. In this area, a large volume of naturally fallen trees of various species belonging to different diametric classes were inventoried, with a higher incidence of trees with small diameter. Therefore, it is important to highlight the potential use of this raw material for development high value-added products as a sustainable income generation opportunity for community members. Thus, the objective of this research was to assess the quality of naturally fallen species through the development of products with a fine finish through technical design projects. For this, was used, defining the types of products and species (*Micrandropsis scleroxylon* and *Simarouba amara*) for the study, characterizing them, surveying the cultural aspects of the RESEX, manufacture of physical products prototypes and analyzing the quality of the wood workability during machining processes. The results obtained through the design projects, demonstrated the quality and feasibility of using wood from naturally fallen trees for the manufacture of products, being able to be explored as a sustainable alternative to generate economic benefits to the community through the valorization of such natural resources of the Amazon rainforest.*

**Keywords:** Amazonian timber, Sustainability, Wood technology, Machining, Product Design, Traditional community

## **1. Introduction**

In order to promote the preservation of forest areas in Brazil, especially in the Amazon, there are demarcations of territories legally protected and, among the management policies at the federal level, are the Conservation Units for Sustainable Use (UC), having as one of its constituent categories the Extractive Reserves (RESEX) (ROCHA, 2010). Such areas used by traditional extractive communities have as basic objectives "to protect the livelihoods and culture of these populations, and to ensure the sustainable use of the unit's natural resources" (BRASIL, 2000) such as forestry.

Among the communities, the RESEX Auati-Paraná in the municipality of Fonte Boa stands out, in which community training projects were developed on the use of wood in the areas of mechanical processing, machining and marquetry, such contents being taught by the laboratory servers of Wood Artifacts Engineering (LEAM) of the National Institute of Amazonian Research (INPA) which, with the support of the INCT Madeiras da Amazônia / PRODERAM / ICMBio project, also promoted the construction of a School Workshop, containing basic machinery and tools joinery (CALEGARE et al, 2014). In this scenario of sustainable exploitation of forest resources by RESEX Auati-Paraná community members, the possibility of using wood from naturally fallen trees stands out. In general, naturally fallen trees are forest residues that consist of trees considered dead due to their fall caused by natural factors such as storms, lightning, windstorms, diseases or old age (NASCIMENTO et al., 2010).

In a study carried out by Rocha (2010) at Resex Auati-Paraná, a high volume of naturally fallen trees per hectare with a diversity of species was observed, and most of the inventoried individuals were contained in diametric classes in the range of 20–50cm, demonstrating the potential use of these woods from the point of view of available stock.

In this perspective, research that explored the use of naturally fallen tree wood (ROCHA, 2010; VIEIRA et al, 2020) emphasizes the importance of using these forest resources as a catalyst between the conservation and sustainable use of wood.

In the scope of the RESEX Auati-Paraná communities, in view of the little used stock of this timber resource, the opportunity of its sustainable exploitation for the development of artifacts (furniture, decorative items, etc.) and small objects stands out (POM) as an alternative for better use and valorization of the raw material. In addition, it can also become an economic activity of generating income for community members through their performance in the wood product market with high added value, as highlighted by Nascimento et al (2010), Rocha (2010) and Higuchi (2013).

In this sense, it is worth mentioning the relevant participation of Design with the helper in the development of products with technical, aesthetic and functional quality. Thus, the importance of the integration between the technical knowledge of Design and the scientific of wood is emphasized, as the sustainable use of this raw material is linked to technological research that promotes its best application (NASCIMENTO, CRISTIANO et al., 2018).

Thus, in order to provide subsidies for the useful destination of these raw materials that are not used in RESEX Auati-Paraná, it is important and necessary the continuous development of studies that generate information on the technological potential and technical viability of wood from trees of course, above all, applied research that practically emphasizes the quality and possibility of using them for processing

products with added value.

Therefore, the major objectives of the research was to assess the quality of naturally fallen tree species through the development of products with a fine finish through technical design projects.

## 2. Material and Methods

For the development of this research, the product design methodology proposed by Munari (2008) was used, also adopting complementary techniques by Bonsiepe (1984) to assist in the design data analysis stage, which are: morphological analysis; structural analysis; requirements and parameters.

### 2.1 Design problems

From the major objective of the research, the definition of the design problem and its components was made, in order to highlight, delimit and facilitate the understanding of the aspects that should be taken into consideration during the development of the Design project.

Therefore, the development of products inspired by the RESEX Auati-Paraná, based on the use of naturally fallen tree wood, was a project problem. As for its structuring into components, the following points were highlighted as relevant to the delineation of the problem:

Table 1. Highlighting and detailing the components of the problem and its aspects.

Components of the problem	Features
A - material	Selection and characterization of two Amazonian species of naturally fallen tree for study
B - concept	Investigation and search for references in the regional aspects of RESEX Auati-Paraná.
C - product	Research and selection of product typology for the development of prototypes.

### 2.2 Collection and analysis of design data

For the stage of data collection and analysis, the aspects of the components of the problem were based. From the data derived from the analysis of such questions, the Requirements and Design Parameters were established. In addition, the selection and characterization of the species of naturally fallen tree was made to make the prototypes.

#### 2.2.1 Material: selection and characterization of the Amazonian woods of the research.

To define the two species of Amazonian wood in the study, a query was made to the database of the Laboratory of Engineering of Wood Artifacts (LEAM) of the National Institute of Research of the Amazon (INPA), about the species from naturally fallen trees with volume enough timber available in the laboratory for development products.

Then, the characterization of the species was done through bibliographic research through consultations of articles, books, dissertations and theses, with the objective of getting to know the species

better and thus obtaining a better basis for analyzing their quality during the machining of the products.

### 2.2.2 Product: Definition and typological analysis

In order to better direct the creative design process of design projects, the product category was delimited in decorative luminaires, and the specific types of pendant lamp and table lamp (candle table lamp / candle holder) were also selected.

Then, through consultations on the website of two design product stores, the study of typologies was made using the techniques of structural and morphological analysis proposed by Bonsiepe (1984).

In the structural analysis, it was possible to understand and outline the basic composition of the selected luminaire typologies regarding their components (parts) and subsystems. In the morphological analysis, the main formal structures were observed regarding the geometric composition (shapes) of the products.

Such schemes (figure 1) collaborated in the stage of generating product alternatives, serving as a basic guide for understanding the typologies.

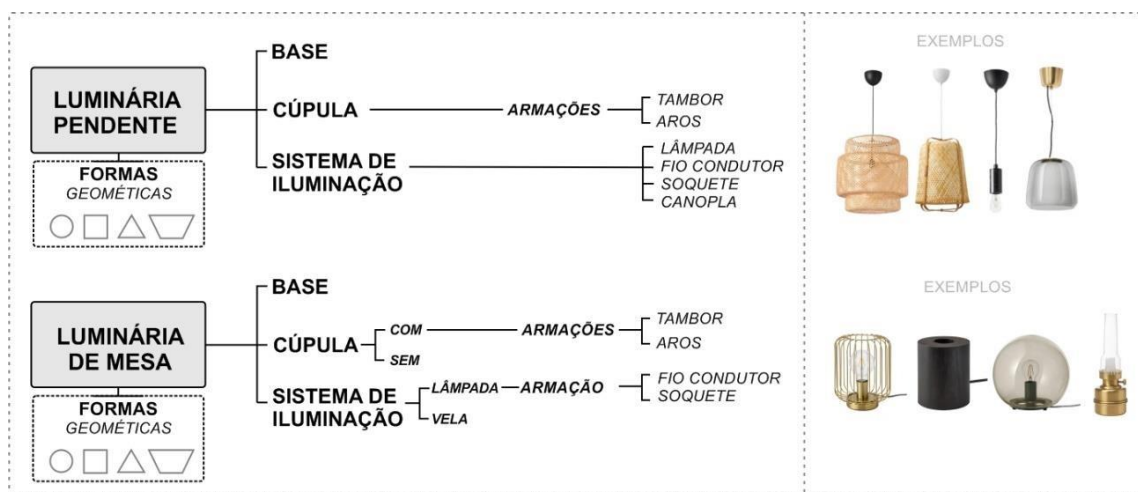


Figure 1. Analysis of the types of luminaires represented graphically in tree diagrams.

### 2.2.3 Concept: regional aspects of RESEX

For the collection of information about the regional characteristics of RESEX Auati-Paraná, consultations were made on the works of Higuchi (2013), Calegari et al (2014) and ICMBio (2011), focusing on the contents regarding the geographical aspect (hydrography), architecture and lifestyle related to the general daily life of the community regarding transportation and work.

From the main characteristics raised about these aspects, two were selected to compose the conceptual basis of the products, which are:

- Transport: boats or canoes;
- Hydrography: External river with muddy color and internal water bodies with dark color.

### 2.2.4 Requirements and Design Parameters

To guide the stage of creative product development, a Requirements and Parameter table was generated containing the main points of orientation to the design process, as indicated by Bonsiepe (1984).



Table 2. Defined requirements and design parameters

Requirements	Parameters
Must present simple forms	Use of basic geometric shapes
Must present regional identity	Conceptualization based on the characteristics of RESEX Auati-Paraná
Must generate little mechanical processing waste	Cutting planning for the best use of timber pieces
Must have productive facility	Use of basic joinery machinery and processes.
It must value the aesthetic characteristics of the wood	Use of heartwood and sapwood
	Aesthetic composition using marquetry techniques

### 2.3 Product design

The generation of product alternatives was initiated through manual sketches on paper as they allow greater freedom and speed in the graphic representation of products. At the end, the two proposals that best fit the requirements and design parameters framework were selected.

Then, three-dimensional digital prototypes were made using the 3D solid modeling CAD software, *Solid Edge ST6*, in which the product's actual volumetric reference was obtained, enabling the improvement of proposals in terms of format, dimensions, construction details and assembly, avoiding possible waste of material both in these processes of evaluation and adaptation of the idea and in the final production of the prototype.

Finally, after making adjustments to the digital prototypes, their technical details were made, which are extremely important to guide the process of making the physical prototypes.

### 2.4 Materials and technology

For the manufacture of physical prototypes, boards of the species *Simarouba amara* (marupá) and *Micrandopsis scleroxylon* W. Rodr (piãozinho), from a naturally fallen tree, were used. For the latter species, it is noteworthy that pieces of wood derived from a shaft considered to be of small diameter were used.

In order to facilitate the production process of the products, basic machinery was used, which can be found in small and medium-sized joiners. In summary, the following equipment, finishing materials and construction techniques were used:

- Machinery: Band saw, circular saw, surface planer machine or a jointer-planer (trowel), planer thicknesser, milling machine (routing cutting), drill and sander;
- Finishing materials: sandpaper for wood, sealer and wax;
- Techniques and processes: Marquetry, cutting, planing, gluing, sanding and drilling.

### 2.5 Experimentation: manufacture of products

The physical prototypes were executed in the joinery of the Laboratory of Engineering and Wood Artifacts (LEAM-INPA) with the support of the responsible technician.

The planing process with a jointer-planer / thicknesser was used for the initial preparation of use of the boards, obtaining pieces with flat surfaces on all their faces and reaching the ideal thicknesses for the pieces

of the products.

For straight cuts and obtaining initial pieces with general dimensions, a circular bench saw was used. The cuts of pieces with sinuous shapes and straight or rounded details were performed with the band saw. To obtain parts with large rounded cutouts in its center, the milling machine (routing cutting) was used for the cutting process.

The bench-top circular sander was used for roughing parts details using N° 60 sanding paper. For finishing, the parts were sanded with machine and manually using sandpaper N° 120, 150, 180, 220, 360, 400, 600, 1200 and 1600 in order to achieve a fine finish on the wood surfaces. Finally, two layers of sealer were applied and then one of natural wax, polishing with flannel to obtain a shine.

It is noteworthy that for making the Candle Holder, residual pieces generated from the mechanical processing of the pendant lamp were reused, thus promoting the maximum use of the wood.



Figure 2. Wood machining processes in the manufacture of physical products prototypes.

## 2.6 Verification: analysis of the performance of forest species

For the analysis of the quality of the wood in the manufacture of fine finishing products, the final result of the physical prototypes was observed, as well as the surface quality of the wood pieces photographed during the machining processes, taking as reference the ASTM D-1666-11 standard adapted and made more flexible to the particularities of this research, that is, served as an evaluation parameter of the results obtained. Therefore, the validation of the species was done through the assessments of the wood surfaces in the processes, prototypes and additional pieces of rectangular shape, with straight edges and with simulation of split fittings typically used in furniture.

## 3. Results and Discussion

### 3.1 Technological characterization of the studied species

- *Micrandropsis scleroxylon* (Piãozinho)

**Scientific Name:** *Micrandropsis scleroxylon* W.Roch

**Family:** Euphorbiaceae

**Common names:** Acapuri, Piãozinho, Peãozinho, Seringarana.

**Additional information:** Initially, studies by Rodrigues (1971) described the species under the binomial *Micrandra scleroxylon* W. Rodr., Including it among the species of *Micrandra*. However, in 1973, with the realization of new studies, the same author updated it for the new genus of the Euphorbiaceae family, naming *Micrandropsis* Rodr.



Figure 3. View of the cross section of the trunk (A); contrast between heartwood and sapwood (B); macroscopic aspect in cross section (C).

Source: Barros (2016) - A; Araújo (2019) - B; Rodrigues (1971) - C.

Table 3. Features of the species *Micrandropsis scleroxylon*

Features	bibliographic survey data
<b>General features</b>	<p>The tree of this species has great occurrence in the Amazonian firm ground forest in the state of Amazonas <sup>(1)</sup> with records also Roraima and Pará <sup>(2)</sup>, in addition to Amapá, Tocantins, Acre, Rondônia and Maranhão <sup>(3)</sup>. It is considered small, with a shaft with a diameter at chest height (DBH) predominantly between 25-34 cm, but it can also be found in a smaller quantity with 35-44 cm and 45-54 cm, more rarely in this last diameter class <sup>(1)</sup>. Corroborating, another study <sup>(4)</sup> registered trees with PAD within these ranges, presenting 44.8–36.2–31.2–30.5 (cm). For the height, it reaches around 25-28 m with the crown <sup>(1)</sup> <sup>(5)</sup> and commercial height approximately between 10.4-17.9 m <sup>(6)</sup>.</p> <p>Regarding its organoleptic characteristics, it is a wood that is heavy, hard and compact; it presents a great contrast due to the color distinction between the uniform dark brown / dark brown heartwood and yellowish / cream sapwood; glossy surface with smooth appearance; receives a neat finish and excellent polishing <sup>(1)</sup>. It has a fine texture <sup>(1)</sup> to medium <sup>(6)</sup> <sup>(7)</sup> and a right grain <sup>(1)</sup> <sup>(7)</sup> to the right for interlocking <sup>(6)</sup>. Growth rings difficult to visualize; it has an indistinct smell and taste <sup>(1)</sup>, but it can exhibit an unpleasant smell when freshly cut <sup>(6)</sup>.</p>
<b>Workability</b>	Not very difficult to machine <sup>(1)</sup> , presenting flat surfaces with little roughness when planing and especially after sanding <sup>(7)</sup> .
<b>Main uses</b>	It is little known despite the relative regional abundance, and is eventually used for stakes, posts, posts, with suggestive use for parquet floors, sleepers, parquet, civil and naval construction, etc. <sup>(1)</sup> ; considered to have timber potential <sup>(3)</sup> .
<b>Physical properties</b>	Basic density values are recorded as: 0.91 g / cm <sup>3</sup> <sup>(8)</sup> , 0.82-0.90g / cm <sup>3</sup> in the sapwood and 0.93-0.97 g / cm <sup>3</sup> in the heartwood <sup>(6)</sup> ; 0.645g / cm <sup>3</sup> <sup>(9)</sup> . In relation

	<p>to apparent density (12% U), 1.176 g / cm<sup>3</sup> <sup>(9)</sup> are recorded. Thus, it is classified as high density wood.</p> <p>Regarding dimensional stability through the anisotropy coefficient, values between 1.29-1.78 are shown, thus presenting dimensional variations considered stable to normal <sup>(6)</sup>.</p>
--	--

Sources: <sup>(1)</sup>Rodrigues (1971); <sup>(2)</sup>Lisboa e Rodrigues (1994 apud ARAÚJO, 2019); <sup>(3)</sup>Cardozo and Vale Junior (2012); <sup>(4)</sup>Medeiros et al (2017); <sup>(5)</sup>Aparecido et al (2019); <sup>(6)</sup>Barros (2016); <sup>(7)</sup>Araújo et al (2019); <sup>(8)</sup>Nascimento et al (2017); <sup>(9)</sup>Araújo (2019).

- ***Simarouba amara* (Marupá)**

**Scientific name:** *Simarouba amara* Aubl.

**Family:** Simaroubaceae.

**Common name:** Marupá, caixeta.

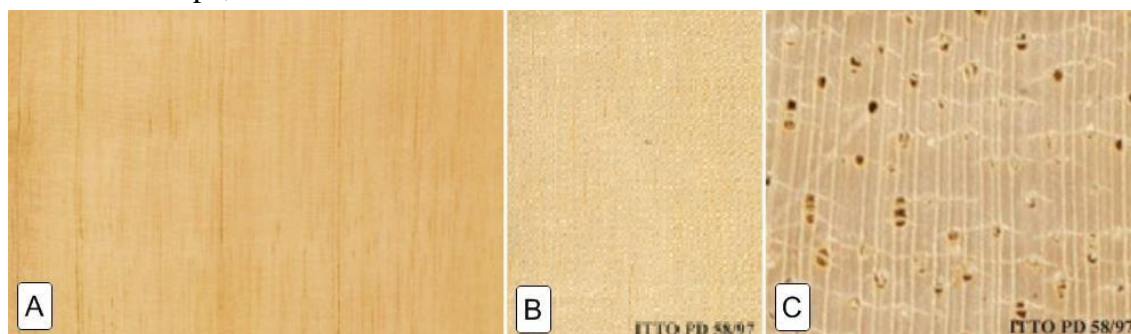


Figure 4. Aspect of the wood on the tangential side (A); View of the radial face (B); macroscopic aspect in cross section (C).

Sources: IPT [2020] – A; ITTO[2020] – B e C.

Table 4. Technological characteristics of the species *Simarouba amara*

Features	bibliographic survey data
<b>General features</b>	Occurrence recorded in the states of Pará, Amazonas, Acre, Mato Grosso and Rondônia <sup>(1)</sup> . It is a large tree, with a circular straight shaft with diameters up to 90 cm; Light wood; indistinct heartwood and sapwood of a bright yellow color that changes over time to yellowish-white; right grain; medium texture; absent figure; indistinct smell; imperceptible to slightly bitter taste <sup>(2)</sup> <sup>(3)</sup> <sup>(4)</sup> . Growth ring limits are not very distinct; absent figure; moderate brightness on longitudinal surfaces <sup>(4)</sup> ; soft to manual cutting <sup>(3)</sup> <sup>(4)</sup> ; smooth surface to the touch <sup>(3)</sup> . Suffers the action of staining fungi <sup>(1)</sup> .
<b>Workability</b>	It is easy to saw, plan, nail, screw and receive a good finish <sup>(2)</sup> . Thus, it is easy to work with manual or mechanical tools, with a superficial finish, it is excellent in sandpaper, drill and planer, but poor in the lathe, in addition it presents good bonding <sup>(1)</sup> .
<b>Main uses</b>	Furniture, general carpentry, joinery and finishing works, boxes, crates,



	compensating, cutlery, musical instruments <sup>(2)</sup> , frames, broom handles, matchsticks, plywood, laminates, among others (1).
<b>Physical properties</b>	Basic density with values of approximately 0.34 g / cm <sup>3</sup> <sup>(3)</sup> , 0.35 g / cm <sup>3</sup> <sup>(2)</sup> and 0.37 g / cm <sup>3</sup> <sup>(1)</sup> being classified as a light wood. As for the apparent density, it presents 0.37 g / cm <sup>3</sup> <sup>(3)</sup> . Regarding the anisotropy coefficient, values such as 1.54 <sup>(2)</sup> and 1.58 <sup>(3)</sup> are reported, classifying wood with good to normal dimensional stability.

Sources: <sup>(1)</sup>Souza et al (2002); <sup>(2)</sup>INPA/CPPF (1991); <sup>(3)</sup>Costa (2017); <sup>(4)</sup>Ribeiro (2017).

### 3.2 Visual characteristics of the samples used

The visual organoleptic characteristics regarding the color and figure of the species were observed on planed boards for better visualization. In general, the visual aspects observed are in accordance with the literature, however, additional descriptive information was generated regarding the aspect of the wood used in the research.



Figure 5. Wood used used to manufacture the products.

The species *Micrandropsis scleroxylon* (Piãozinho) has distinct heartwood and sapwood. The heartwood was dark brown in color with the presence of fine fine bands of tone close to black. The sapwood exhibited uniform yellowish color with the occasional presence of some thin grayish streaks. In general, the figure is absent, however, such variations of linear shades in some pieces attribute additional visual elements to wood.

The species *Simarouba Amara* (Marupá) showed no distinction between heartwood and sapwood, showing a yellowish-white color or straw shade and an absent figure. In the pieces used there was the presence of a staining fungus, attributing to the wood black linear figures with curvilinear shapes, giving the pieces an aesthetic aspect not characteristic of the species.

### 3.3 Behavior of wood in the manufacture of products

From the observation and evaluation of the workability of the species in the machining processes, it was possible to analyze the quality and potential of use in products with higher added value.

As for the ease of machining, the species *Micrandropsis scleroxylon* (Piãozinho) showed slight resistance to thinning due to the hardness of the wood.

In the planing process with a planer and thicknesser, it presented excellent surfaces without apparent defect and with a smooth and glossy aspect. (figure 7-A and B)

In the cuts with the circular saw, band saw and milling machine, the results obtained on the surfaces and edges of the wood were excellent, with no considerable breakage or chipping of fibers (fluff) (figure 7-C to H).

As for the drilling process with a flat drill, it showed excellent edges, with a defect (tearing of woody material) only at the bottom of the hole when not passing through. With the helical drill it also presented excellent edges, with the occasional presence of slight fibrous chills in some slits made by the successive drilling method (mortising), however, they are easily corrected with sanding or with a blade (figure 7 - I to K).

In the sanding process there was no difficulty in obtaining a smooth and glossy surface, considering that the planing process already generates an excellent finish on the parts. The use of sandpaper with granulometry 120, 150, 180, 220 and 360 was sufficient to achieve an excellent result with evident shine. It is noteworthy that the use of sandpaper 400 and 600 collaborated with the accentuation of the chandelier, being complementary those of grain size 1200 and 1600 to guarantee maximum brightness, however visually no great differences were noticed (figure 5 - L).

Regarding the bonding with white PVA glue, it presented an excellent result in the marquetry technique with joining in pieces of other timber (*Simarouba amara*), showing no detachment tendency when used in the saw cut and flat drill hole processes. Glued together, it presented a good result, but it is advisable to reinforce it with screws in top fittings for larger products, such as furniture.

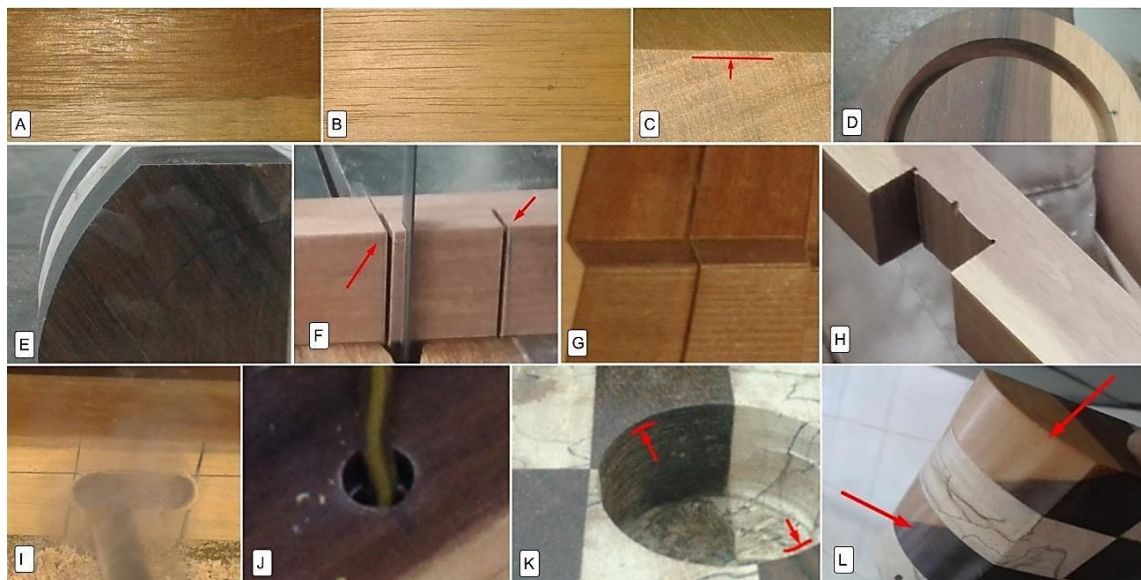


Figure 6. Finishing the surfaces of Piãozinho wood in machining processes

The species *Simarouba amara* (Marupá) presented good surfaces resulting from the planing process with the thicknesser and jointer-planer, however, chips were observed in some points on the board surface (figure 6-A)

As for the cut with a circular saw and a band saw, it showed a good result in terms of the edge finish (figure 8 - D and E), with the presence of fibrous chills being uncommon (figure 8 - B and C). Regarding



the cutting process with milling (routing cutting), it obtained surfaces with excellent finish (figure 8 - H).

The hole with a flat drill obtained a good finish on the edge, with the occasional appearance of fibrous chills, but with pullout on the bottom surface of the non-through hole (figure 8- F).

The finishing of the sanded parts had excellent surfaces and was easily hand-machined, reducing the process time. In order to promote a smooth appearance and avoid a fuzzy touch, sandpaper of granulometry nº 120, 150, 180, 220, 360, 400 and 600 were used, where the use of sandpaper 1200 and 1600 was optional for straightening, without showing relevant differences. As for the surface luster, little glare was noted on the absent one (figure 8 - I).

As for gluing, it showed excellent performance in the marquetry technique when glued together with the species *Micrandropsis scleroxylon* (Piãozinho) and also with pieces of the same species.

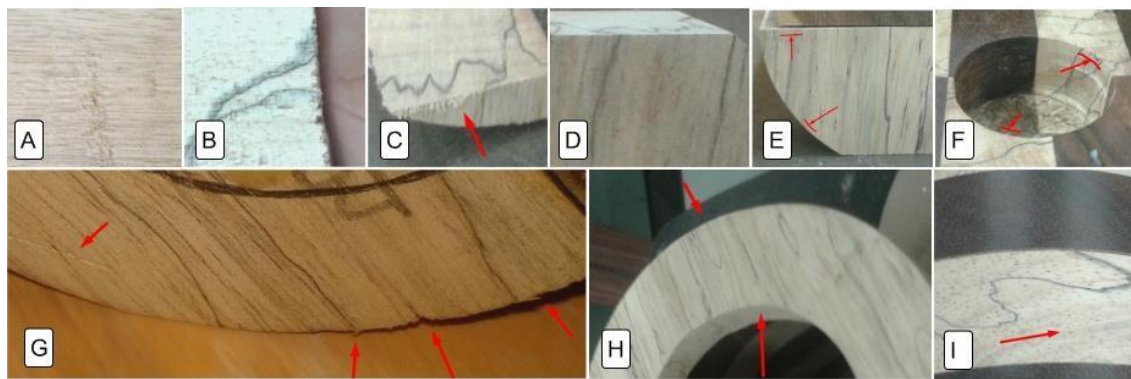


Figure 7. Finishing the surfaces of Marupá wood in machining processes

### 3.4 General results of workability

In general, it was found that both species showed positive results in terms of surface quality in the machining and finishing processes, the evaluation of which is summarized in table 5.

Table 5. Evaluation of machining tests

Machining processes	Species and classification	
	<i>Micrandropsis scleroxylon</i> (Piãozinho)	<i>Simarouba amara</i> (Marupá)
Cutting	Excellent	Good
Milling cutting (routing cutting)	Excellent	Good
Planing	Excellent	Good
Sanding	Excellent	Good
Drilling - Flat Drill	Excellent	Good
Drilling - Helical Drill	Excellent	-
Collage	Excellent	Excellent

The species presented different facilities regarding the thinning of the wood material by manual machining and with machinery, with Marupá being more easily worked than Piãozinho. Such behavior can

be explained by the density, since high density woods have greater hardness and consequently less ease in terms of workability (BURGER and RICHTER, 1991; MADY, 2000).

The hardness of the wood also influenced the susceptibility of the surfaces to suffer markings by impacts with sharp objects, and it was observed that Marupá, a low density wood, showed easier to acquire marks (figure 8 - G) compared to Piãozinho, of high density, which demonstrated good resistance.

According to Araujo et al (2019), studies on the roughness of the wood surface indicate that it suffers a relevant influence from the density it has, having been observed through the analysis of species of medium and high density that, in general, woods of greater density have less rough surfaces, that is, with less irregularities and consequently more flat and smooth.

Such behavior was observed in this research through the excellent results achieved on the machined surfaces of Piãozinho, going against what was found by Araújo (2019) in his study on its roughness. The author pointed out that this high density species showed low roughness on the planed surface without sanding as well as good performance in reducing this roughness with the use of sandpaper 120 and 180, obtaining smooth surfaces.

Still with regard to the good quality of the wood finish in the machining processes, the type of grain and texture are also indicative of the positive result achieved, as woods with straight grain and fine texture tend to have a greater facility in obtaining a good surface finish in the processes (MADY, 2000). Thus, according to the data collected on the organoleptic characteristics, both species are identified as having the right grain and have a texture classified between fine and medium, thus indicating factors that contribute to the good performance observed.

Regarding the use of heartwood and sapwood, with an emphasis on Piãozinho wood, it is noteworthy that no distinctions were noted regarding the quality of the woody material during the processing of the pieces, that is, they presented similar performance with excellent finish.

Regarding the presence of staining fungi in the pieces of Marupá, they did not show any negative influences on the machining of the wood or the final result of the product, contributing positively to its aesthetics. It is reported that, in general, the presence of staining fungi does not significantly alter the mechanical strength of wood, affecting mainly its aesthetics (MORESCHI, 2013). For artifacts or small wooden objects, pieces with a similar look to the one used in this research can be a positive point, as seen in the products generated, thus indicating the importance of evaluating the possibility of using stained wood for use in product projects along the way. instead of discarding them soon.

It is also noteworthy that during the manufacturing processes as well as after the finalization of the products, the wood did not show dimensional changes, indicating good stability. Such a result was expected due to the anisotropy coefficient reported in the literature for these species, with dimensional variations considered stable to normal according to classification based on Galvão and Jankowsky (1985 apud COSTA, 2017).

### ***3.5 Manufactured products***

The two products produced showed technical feasibility, aesthetic and functional quality, meeting the demands of the market for the design of wood products with a fine finish. The concepts generated for the creation of the products sought to represent aspects of the Resex Auati-Paraná as well as to value the

aesthetic beauty of the woods. Through the technique of marquetry, the contrast between the colors of the wood was evidenced, making reference to the different shades between the waters found in the surroundings and interior of RESEX Auati-Paraná.

The suspended luminaire named “Rio” used as inspiration for the thematic concept the beauty and movement of the rivers, represented in the side cutouts that are highlighted in the product through internal lighting.



Figure 8. Prototype of the suspended luminaire finished and in use.

For the table lamp, a lamp was developed characterized as a modular table support for 36mm réchaud candles, named “Modulare”, having as conceptual inspiration lamps used as one of the lighting means, where the candle represents the points of light seen at night in the darkness. In addition, its frontal shape alludes to the canoes used for locomotion in the RESEX. As it is a modular part, it allows several configurations by joining several units in different arrangements.

Bearing in mind that the “Modulare” luminaire was made from the waste generated during the production of the “Rio” luminaire, the importance of the Design project is realized, which, through technical planning of the product, enabling a higher yield of the due to the reduction in the production of waste pieces during the beneficiation process.

This advantage was also observed through the use of the sapwood of Piãozinho wood, a part that is usually discarded. With the manufacture of the products, it was demonstrated that this woody part can also be used in the manufacture of products with a fine finish, enabling the increase of the wood yield, as highlighted by Fróes et al. (2019). In addition, the use of pieces of the Piãozinho species derived from a shaft considered to be of a small diameter, it has been shown that trees naturally fallen within smaller diametric classes can also be used by the community to manufacture products.



Figure 9. Prototype of the table lamp, with candle, finished and in use.

#### **4. Final consideration**

It is noteworthy that, given the results exposed through the product design and machining analysis projects, it contributed to the strengthening of technical-scientific information about the quality and viability of sustainable use of wood from naturally fallen trees for the manufacture of products with added value, thus providing subsidies to Organs managing bodies of RESEX Auati-Paraná regarding the possibility of using these forest resources by the local community.

#### **5. Conclusion**

The wood of Amazonian tree species of naturally fallen trees performed well in the machining and finishing processes, proving technically feasible for processing in products with high added value.

The species *Micrandropsis scleroxylon* showed excellent machinability in wood from both heartwood and sapwood and can be used for the development of products with a fine finish.

The development of technical design projects proved to be important for the good planning of products, collaborating with the maximum use of wood through the reduction of waste generated during processing.

Finally, it is concluded that the use of these forest resources for the production of products is an alternative that can be explored as a sustainable opportunity for income generation of RESEX Auati-Paraná community members.

#### **6. Acknowledgement**

The main author is grateful for the research support grant made available by development agency: Fundação de Amparo à Pesquisa do Estado do Amazonas (FAPEAM).

#### **7. References**

APARECIDO, L. M. T.; SANTOS, J. dos; HIGUCHI, N.; KUNERT, N. Relevância da anatomia da madeira e do tamanho das árvores amazônicas na determinação e alometria de área de alburno. Acta Amaz. Manaus, v. 49, n. 1, pág. 1-10, março de 2019.

ARAÚJO, R. D. de. Avaliação do potencial de espécies manejadas na amazônia para produção de painéis “egp” (edgegluedpanels) não estrutural. 115. Tese (Doutorado – Programa de Pós-Graduação em Ciências de Florestas Tropicais), Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, 2019.

ARAUJO, Roberto Daniel de et al . Surface roughness of edge gluedpanels (EGP) of amazon managed species. Ciênc. agrotec., Lavras , v. 43, e19119, 2019

AMERICAN SOCIETY TESTING AND MATERIALS. ASTM D 1666-11: standard method for conducting machining tests of wood and wood base materials. Philaladelphia, 2011

BARROS, S. V. dos. Avaliação da qualidade da madeira de árvores da Amazônia por método não

destrutivo de propagação de onda: tomógrafo de impulso e stress wave timer. 134f. Tese (Doutorado – Ciências de Florestas Tropicais), Instituto Nacional de Pesquisas da Amazônia, Manaus, Amazonas, 2016

BONSIEPE, Gui. Metodologia Experimental: Desenho Industrial. Brasília: CNPq / Coordenação Editorial, 1984.

BRASIL, LEI Nº 9.985, DE 18 DE JULHO DE 2000: D.O. DE 19/07/2000, P. 1. Ministério do Meio Ambiente, 2000.

BURGER, L. M; RICHTER, H. G. Anatomia da Madeira. São Paulo, 153p. 1991.

CALEGARE, M.G.A.; HIGUCHI, M.I.G.; MOREIRA, K. C. A.; LIMA, J.H.T. Transformações no modo de vida dos habitantes da ResexAuati-Paraná, a partir da introdução de uma estratégia de desenvolvimento sustentável. Relatório Técnico Final. Manaus, Amazonas, 2014.

CARDOZO, I. B.; VALE JUNIOR, I. C do. Etnozoneamento da Porção Paraense das Terras Indígenas Trombetas-Mapuera e Nhamundá-Mapueraled. 200p. Porto Velho-RO: EDUFRO, 2012.

COSTA, Joelma Araújo. Classificação de madeiras da amazônia para composição de instrumento musical de corda por meio da técnica de excitação por impulso. 127 p. Dissertação (Mestrado em Ciências Florestais e Ambientais) – Engenharia Florestal, Universidade Federal do Amazonas, Manaus, Amazonas, 2017

FRÓES , D. F. .; NASCIMENTO, C. C. do .; FREITAS, J. A. de .; SILVA, G. M. .; ARAUJO, R. D. de .; DANTAS, G. dos S. .; FILHO, P. D. F. de S. P. . Managing the Technological Potential of *Eschweilera truncata* A. C. Sm in theAmazon. International Journal for Innovation Education and Research, [S. l.], v. 7, n. 11, p. 585–598, 2019.

HIGUCHI, M. I. G.; FREITAS. et al. *Aspectos legais das Unidades de Conservação*. In: FERNANDES, M. L. F, C. C.; HIGUCHI, N. Morar e viver em unidades de conservação no Amazonas: considerações socioambientais para os planos de manejo. Manaus:[s.n.], 2013.

ICMBio – Instituto Chico Mendes de Conservação da Biodiversidade. Plano de Manejo Participativo da Reserva Extrativista Auati-Paraná. 359p. Tefé, Amazonas, 2011.

INPA/CPPF – Instituto Nacional de Pesquisas Da Amazônica. Catálogo de madeiras da Amazônia: Características tecnológicas, Área da Hidrelétrica de Balbina. 163p. CPPF/INPA, Manaus, 1991.

IPT - INSTITUTO DE PESQUISAS TECNOLÓGICAS. Informações sobre madeiras: Marupá. [2020] .Disponível em:<[http://www.ipt.br/informacoes\\_madeiras/43.htm](http://www.ipt.br/informacoes_madeiras/43.htm)> Acesso em 18 nov. 2020.

ITTO – IINTERNATIONAL TROPICAL TIMBERORGANIZATION. .Lesser Used Species: Marupa (Simarouba Amara). Disponível em:<<http://www.tropicaltimber.info/pt-br/specie/marupa-simarouba-amara/>> Acesso em 18 nov. 2020.



MADY, Francisco Tarcísio Moraes. Conhecendo a madeira: informações sobre 90 espécies comerciais. Manaus: SEBRAE/AM, 2000.

MEDEIROS, R. G. S; NASCIMENTO, C.C.do; BARROS, S. V. dos; KROESSIN, A; PAULA, E. V. C. M. de; HIGUCHI, N. Tomografia de impulso na avaliação da sanidade e rendimento de *Micrandopsis scleroxylon* W. Rodr.. Revista Nativa, Sinop, v.5, esp., p. 649-655, dez. 2017.

MORESCHI, J. C. Biodegradação da Madeira. Biodegradação e Preservação da Madeira, 4ª edição, v.1. Universidade Federal do Paraná: 2013.

MUNARI, Bruno. Das Coisas Nascem Coisas. 2. ed. São Paulo: Martins Fontes, 2008. 378 p.

NASCIMENTO, C. C. et al. O uso de madeiras de árvores caídas em comunidades extrativistas: Estratégia econômica e de sustentabilidade ambiental. Manaus: INPA, 2010.

NASCIMENTO, C. C. do; BRASIL, M. M.; NASCIMENTO, C. S. do; BARROS, S. V. dos. Estimativa da densidade básica da madeira de *Eschweilera odora* (Poepp.) Miers por espectroscopia no infravermelho próximo. *Revista Ciência da Madeira (Brazilian Journal of Wood Science)*, v. 8, n. 1, P.42-53, 2017.

NASCIMENTO, Cristiano S. do; NASCIMENTO, Claudete C. do; HIGUSHI, N.; CRUZ, I. de A. Caracterização tecnológica da madeira de mata-mata (*Eschweilera odora* Poepp.Miers). In: Anais do Seminário Internacional em Ciências do Ambiente e Sustentabilidade na Amazonia, v.5, Volume 5, pg. 1-11, 2018

RIBEIRO, Edilene Silva. Propriedades tecnológicas de vinte espécies de madeiras tropicais comercializadas pelo estado de Mato Grosso. 2017. xxvi, 183 f., il. Tese (Doutorado em Ciências Florestais)—Universidade de Brasília, Brasília, 2017.

ROCHA, Janaína de Almeida. Madeira caída como oportunidade para o manejo florestal comunitário em unidades de conservação no Amazonas, Brasil. Dissertação (Mestrado em Ciências de Florestas Tropicais). CFT/INPA, Manaus, 2010.

RODRIGUES, William A ..*Micrandrascleroxylon* W. Rodr., Nova Euforbiácea da Amazônia Brasileira. *Acta Amaz.* , Manaus, v. 1, n. 3, pág. 3-8, dezembro de 1971.

RODRIGUES, William A ..*Micrandropsis*, novo gênero de Euphorbiaceae da Amazônia. *Acta Amaz.* , Manaus, v. 3, n. 2, pág. 5-6, agosto de 1973.

SOUZA, Maria Helena de; MAGILIANO, José Arlete C. Madeiras tropicais brasileiras. 2 ed, ver. Brasília: Edições IBAMA, 2002.

VIEIRA, M . S.; NASCIMENTO, C. C. do; HIGUCHI, N .; PACHECO, K. M. M. Avaliação da qualidade da madeira de árvores caídas naturalmente na Amazônia central. *Jornal Internacional para Educação e Pesquisa em Inovação* , [S. l.] , v. 8, n. 8, pág. 564–579, 2020.



# **Teaching practice for pandemic times and the empowerment of audiovisual didactic sequences**

**Carina Dias da Silva Rodrigues**

Federal Institute Farroupilha,  
Santa Maria-RS, Brazil.

ORCID: <https://orcid.org/0000-0002-6067-9903>

Email: [carina.dias@iffarroupilha.edu.br](mailto:carina.dias@iffarroupilha.edu.br)

**Andréia dos Santos Sachete**

Professor, Dept. of Languages, Federal Institute Farroupilha,  
Alegrete-RS, Brazil.

ORCID: <https://orcid.org/0000-0003-2226-3322>

Email: [andreia.sachete@iffarroupilha.edu.br](mailto:andreia.sachete@iffarroupilha.edu.br)

**Fábio Diniz Rossi (Corresponding author)**

Professor, Dept. of Computer Science, Federal Institute Farroupilha,  
Alegrete-RS, Brazil.

ORCID: <https://orcid.org/0000-0002-2450-1024>

Email: [fabio.rossi@iffarroupilha.edu.br](mailto:fabio.rossi@iffarroupilha.edu.br)

## **Abstract**

*Closed gates and students away from classrooms consist of scenarios with thousands of schools in different countries, showing all the zeal we must have with teaching, which was opened wide by the indirect relationship between Education and Coronavirus. It is a frightening and troubling panorama, not only in health but also in teaching impacts. The learning process can and should happen outside the classroom, and the pandemic accelerated this understanding. Technology support is fundamental for this to happen, eliminating any physical or geographical barrier of communication and interaction. However, the technological tools go further. Educational technologies are the leading solution to our situation and have the most significant potential for teaching children and young people. It is an opportunity to reframe Education and think of more effective ways to develop new children and young people. However, there is no ready recipe. Several frameworks for creating can guide audiovisual didactic sequences are not entirely descriptive in practice, applicability, or evaluation. Therefore, this work has its starting point the instructional design to supply this development, with other frameworks within its phases, allowing a better understanding of the objectives and greater ease in developing the instructional material. The results show that students well accept this new proposal.*

**Keywords:** didactic sequence; instructional design; system usability scale; storytelling

## **1. Introduction**

The pandemic of the new coronavirus, COVID-19, closed many schools of regular and professional education throughout Brazil. This is one of the measures to contain the disease and reduce contagion. In this scenario, many school managers had to seek emergency exits to continue their activities. Mainly, remote teaching supports and the introduction of new methodologies, supported by digital technologies (Viner et al., 2020).

After all, from one hour to the next, face-to-face classes were replaced for remote learning<sup>1</sup>, forcing teachers and students to learn new communication and information technologies (ICTs) quickly. In addition to infrastructure and connectivity issues, the implementation of new teaching modalities rapidly, due to the pandemic, highlighted the need to prepare teachers and school managers (Goldman et al., 2020). However, that doesn't happen as quickly as using technology. There is a tendency for teachers to reproduce the face-to-face model, using the same calendar and curriculum. And this is the main problem because the pedagogical posture in distance learning is different. In the classroom, feedback between student and teacher is direct and permanent. Just look around to see if there is student engagement, if the class understands what is being taught, etc. In distance learning, there is no such control. Hence the need to think about solutions and rethink practices (Baticulon et al., 2020).

In this scenario, several teachers are returning their interest in audiovisual material production, mainly due to its ease of consumption (Al Lily et al., 2020). Especially for children, videos are an excellent learning alternative, as students are more focused and can still learn while playing. Thus, proposals for audiovisual material are widely produced. However, there are still some challenges that these teachers must overcome with their audiovisual materials: the lack of clear understanding of the class, the lack of clarity and information overload, the lack of creativity, and the lack of time management. Thus, teachers are looking for some frameworks that can assist in audiovisual production, such as instructional design (Iivari et al., 2020).

However, it brings a problem: instructional design also does not address the challenges teachers must overcome. On the contrary, instructional design has historically presented the same challenges (Sweller et al., 2019). This means that only a more complete model that can, besides guiding audiovisual material development, can offer educational tools that really give meaning and organize the didactic sequences is necessary. Therefore, this work aims to empower the instructional design phases with the addition of other validated and well-known frameworks, focusing on the development of didactic sequences that provide meaningful learning.

## **2. Teaching practice in pandemic times**

---

<sup>1</sup> In Brazil, distance learning and remote learning are different. Each has its legislation, and courses approved as in-person by the Ministry of Education cannot be offered in the distance learning "mode" (which have their legislation). For this reason, we call the current model of education as "remote."

Teachers' preparation (Imbernon, 2009), both initial and permanent, is directly influenced by changes in reality and makes the teacher face daily changing contexts, whether socio-cultural, economic, valuation, or technological. Faced with a universal culture and a constantly changing reality, teacher autonomy, and self-determination are based on the best choices from an epistemological and methodological perspective. The teacher's commitment and competence to be able to develop (trans)formative practices in these changing scenarios is the focus of discussion by several authors, such as Paulo Freire (Freire, 2008).

Educational institutions must be environments in which teachers can reflect on their actions, confront theoretical knowledge, and, starting from these dialogues with heuristic pretensions, be able to understand, explain and overcome the challenges that may arise in their school routine. This means that teachers must have an ecosystem in which reflection on and about professional action is translated into a pedagogical action (Tardif, 2014). However, one cannot idealize a context, the daily life "of" and "in" praxis will always present many dilemmas and counterpoints, so the best way is to guarantee this capacity for resilience and at the same time reading and transforming the context based on production and dissemination of knowledge. Considering the assertion that teaching knowledge is also built, it is educational institutions' role to encourage reflection and discussion of their own practice (Tardif, 2014). It is essential to move beyond the horizon of diagnoses, recognize the difficulties inherent in the teacher's formation process, and offer them the conditions to overcome these constraints. No undergraduate degree meets all the formation needs of teaching; it serves as an initiation that needs to be complemented throughout professional life, according to the demands and difficulties encountered in praxis. To be a teacher is to do it constantly. It is essential to move beyond the horizon of diagnoses, recognize the challenges inherent in the teacher's formation process, and offer them the conditions to overcome these constraints.

According to Paulo Freire (Freire, 2001), Education is permanent because, on the one hand, about the finitude of the human being, on the other, about the awareness he/she has of his/her finitude. Furthermore, since, throughout history, it incorporated into its nature, not only knowing that it lived but knowing that it understood and, thus, knowing that it could learn more. Education and ongoing formation are joined there.

The premise for this formative movement must be born from the Freire's inference that the teacher must feel inconclusive; with this and for this reason, he is on his way to an endless search for answers to the daily impositions of praxis. Teaching is a process of critical dialogical relationship with our human condition so that what we have is the only inconclusion. We are living in the construction processes. From these realities, it is possible to envision the spaces of teacher formation as a locus of listening, interaction and sharing, and, consequently, of learning capable of recognizing the contemporary daily education, which integrates different learning styles of the subjects in a constitutive and constructive, showing that the teacher's identity characterization is (re)transformed.

In the wake of the vision presented above, our formative gap is most straight-forward if in the human condition itself, considering that we cannot predict everything all the time. Especially in this pandemic moment in which we live. Suddenly imposed on all levels of education and educational institutions, the challenges generated by Education during the pandemic have brought factual repercussions and definitely change teaching and learning. Thus, teachers' and trainers' role is to find ways out for all students to have

access to quality education at all levels. This means much more than teaching content. It is a profound (re)thinking about our teaching forms and, mainly, ways of learning.

The education space should enable an environment in which teachers can reflect on their actions, confront theoretical knowledge, and, starting from these dialogues with heuristic pretensions, understand, explain and overcome the challenges that may arise in their school routine (Tardif, 2014). The teacher's commitment and competence to be able to develop (trans)formative practices in these changing scenarios is the focus of discussion by several authors (Freire, 2008).

In the current scenario, many school managers had to seek emergency ways to continue their activities. Mainly, with the help of remote teaching supports and the introduction of new methodologies supported by digital technologies. After all, from one hour to the next, face-to-face classes were substituted for the remote teaching modality, propelling teachers and students to rapid learning of new information and communication technologies (ICTs). However, teachers share several insecurities regarding more technical issues, such as giving the class online, recording videos, and preparing materials shared with students. In this sense, it was noticed that there is a deficit in teacher formation in ICTs and active methodologies, something that makes engagement difficult. Furthermore, this preparation takes time, does not happen overnight (Colao et al., 2020).

Additionally, education, technology, and autonomy must go together. The use of technology in education should have the character of technological praxis since all use of technology is initially imbued with ideology. It is necessary to identify the bases of technological practices searching for the real justifications for their use. From the axiological point of view, as well as epistemological, all use of technology is based on conceptions of the world and of the man imagined by a certain ideology, notably on issues of education. Technology cannot be used without fully understanding the real reason for its use since the possibility of political-ideological manipulation also permeates technological environments and environments. The full understanding of technology humanizes men and makes them able to transform the world, which is, in fact, praxis (Freire, 1996). Based on the above, we propose improvements in the instructional design. It covers all the pedagogical-methodological issues necessary to develop audiovisual material to meet the didactic sequences needed for remote education during the pandemic period.

### **3. Instructional Design**

Instructional design (ID) (Sweller et al., 2019) is an area of activity linked to Education, more precisely, to teaching materials. It can be understood as a work methodology dedicated to analysis, design, development, implementation, and evaluation of distance courses.

The ID constitutes a set of activities involved in the formulation of educational action; that is, it is a diversity of practices that allow the construction of a qualified educational product. ID is responsible for the structure and organization of material production, for the content material adequacy of the content (accordance with the content) and their level of approach, for adapting to the student's profile and context, for verifying the methodological and pedagogical objectives proposed by the course, through the use of appropriate language and information, accessible to the purposes, to the subjects involved in learning and the proper appropriation of the media. The ID presents four basic assumptions:

1. To elaborate effective didactic processes and materials, that is, that fulfill their pedagogical objectives.
2. Materials and methods must be efficient, using the shortest possible time.
3. It must be pleasant for apprentices.
4. They need to be viable in terms of cost-benefit

The advantages of ID include (i) establish the focus of the teaching-learning process on the student, (ii) encourage the development of alternative solutions to the usual practices in a given teaching area, and (iii) promote the convergence of objectives, activities, and evaluations.

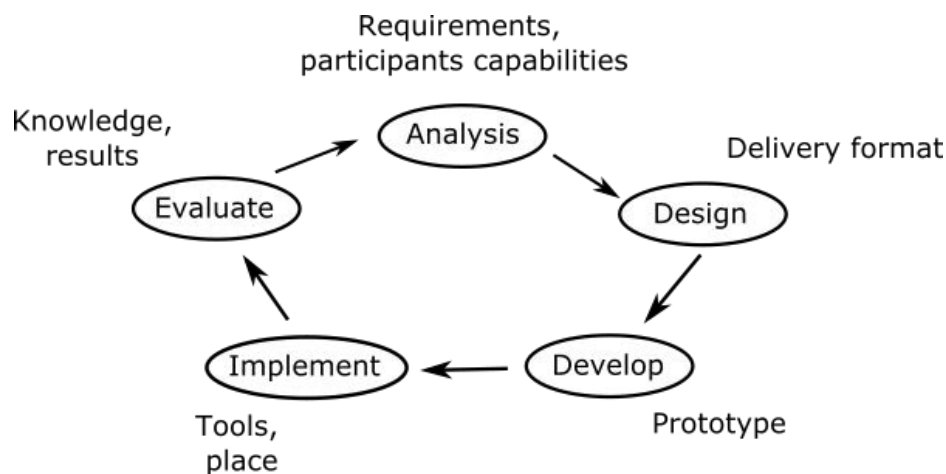


Figure 1: ADDIE model.

The ID can be divided into five phases: analysis, design, development, implementation, and evaluation. These phases constitute the so-called ADDIE model (Figure 1), a continuous and cyclical chain fed back at the end of the process. This model can be adopted at the macro level, in the elaboration of courses, and at the micro-level, to develop teaching materials.

### 3.1. Analysis

In this phase, the philosophies of education that guide the institution are defined, the course's objectives, the characterization of the target audience, the context's analysis, and the technological infrastructure, media, and communication support. It consists of understanding the educational problem and designing an approximate solution. Among others, the following aspects can be observed: (i) the nature of performance problems, (ii) the context in which the formation needs originate, (iii) the performances that must be the object of formation, (iv) the type of educational process to be adopted, (v) the definition of the target audience, and (vi) the schedule and costs of the formation project.

### 3.2. Design

It refers to creating the team responsible for the curriculum's content and definition, schedule, and pedagogical and technological strategies. In summary, this phase involves mapping and sequencing the contents, defining learning strategies and activities to achieve the objectives set, selecting the media and tools, and describing the materials that should be produced. The following aspects stand out in this stage: (i) the learning objectives, (ii) the content suited to the desired performance, (iii) the prerequisites for learning, and (iv) the learning sequence.

### **3.3. Development**

Stage in which the instructional material is prepared, according to the available media and the chosen platform. Technical and pedagogical support is also defined. It involves the production and adaptation of printed and digital resources and teaching materials. The following aspects are observed in this stage:

(i) the characterization of educational activities, (ii) the selection of teaching resources, (iii) the review of existing material, (iv) the formatting of the formation program (course curriculum), (v) the selection of content, (vi) the definition of the teaching staff and their duties, and (vii) the formation validation test.

### **3.4. Implementation**

In this stage, learning units are made available; students carry out the proposed activities interacting with the contents, tools, and educators. The application of the instructional design proposal will be evaluated in the subsequent evaluation phase. In addition to the formation itself, this stage involves the pedagogical proposal's physical and administrative structure.

### **3.5. Evaluation**

It comprises the review and analysis of the pedagogical and technological strategies adopted. It covers considerations on the effectiveness of the proposed solution and the study of implemented strategies. In this phase, the evaluation of both the educational and learning results occurs, making it possible to adapt the instructional design. In summary, the evaluation allows the continuous improvement of the teaching process. The focus of pedagogical assessment is not on the format or technical qualities of its production. Still, on its pedagogical characteristics, that is, how much it can contribute to student learning. For this reason, the assessment should consider the student's performance concerning what was planned. The verification of effectiveness must allow the recognition of evidence of gains: it can be about the learning of concepts or the development of skills and competencies, which can be measured continuously or at the end of a period.

## **4. Challenges and Proposal**

In the direct relation of the subject to the learning object - where the student acts on the learning objects and not the other way around, as occurred in the traditional teaching model - and since education occurs in several places and ways (globalized world), what are the challenges of instructional design today? We left a cast-off teaching model, where banking education is no longer applicable - the teacher is the depositor of meaningless content, and the student is only the depositary. Here are some challenges for the work of instructional design (Law and Wong, 1995):

1. Since we live in a globalized world and the amount of information is pervasive on any subject, how to organize the required content to meet the needs and objectives?
2. How to present and methodologically develop these contents to students?
3. Another challenge is the adequacy of time for each activity. What is the ideal time so that the activity does not become tiring and fails to meet your goals?



4. How to work theory vs. practice in courses/formation? How to transform the teaching-learning process into meaningful learning?
5. How to evaluate, to know if the students achieved the objectives? Which assessment strategies to choose?
6. What about students who have learning difficulties? How to intervene and interact with them?
7. How to adapt the instructional project to the reality of those who requested it (human, financial and technical resources, available), without the proposal losing its pedagogical consistency?

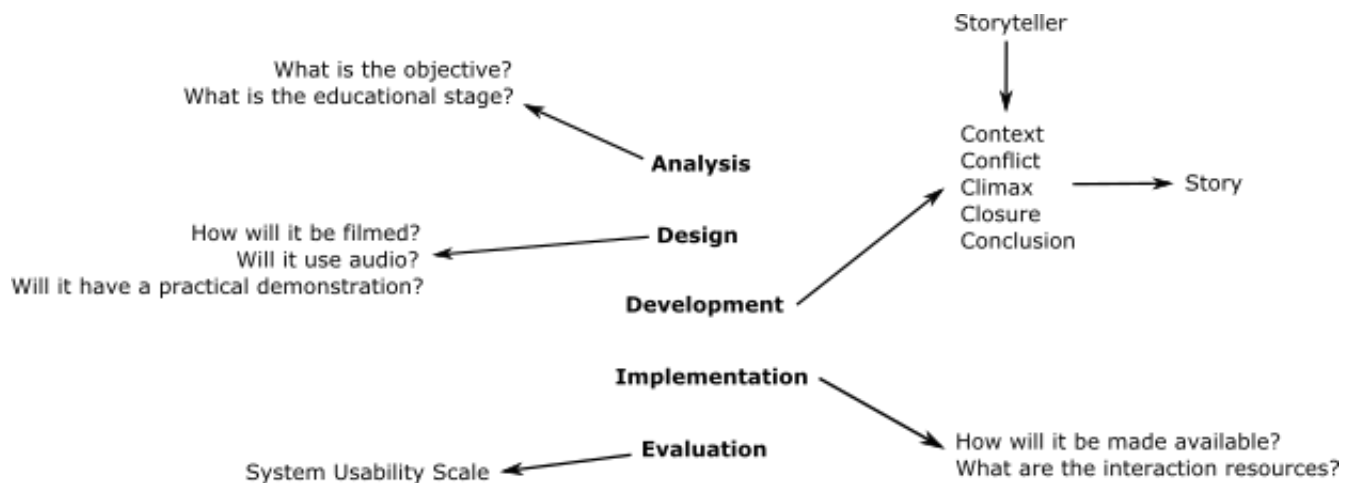


Figure 2: Empowered instructional design.

In order to answer these questions, this work presents two-stage empowerment of instructional design using two other well-known frameworks. This proposal can be seen in Figure 2. The development phase is guided by story-telling, and the system usability scale drives the evaluation phase. The analysis, design, and implementation phases are guided by fundamental questions that guide the didactic sequence's total development.

For example, in the analysis, questions are asked that determine the class's purpose and the level of education involved. In the design phase, the characteristics of the digital material production are defined in practical terms. And in the implementation, questions are defined about the availability and interactive resources that the digital material will have. Below we present the two frameworks added to the instructional design.

Table 1: Storytelling Phases and Descriptions.

Phase	Description
Context	To contextualize means to approach the theme in order to identify in theory, or in what it is intended to teach, the situation or the context in which the student is inserted. A relationship must be established between what the student learns at school and his life (your daily life, health, relationship with society, and the environment). It indicates that learning will have meaning and be relevant to the student.

Conflict	Conflict must be able to discomfort, generate anguish instigate the student to interact with the context of the lesson through the teacher's problematization proposal. This should make the students pass from the quality of teaching objects to subjects of their learning.
Climax	The climax is the moment when the narrative is taken to the point of high tension or emotion, a kind of "literary crossroads" that requires a decision or an outcome.
Closure	Closing is the part of the narrative that shows the solution to the conflict. This consists of the end of the lesson, but not the end of the class.
Conclusion	The class's conclusion is the moment when the teacher establishes in the space of the discipline, where this lesson is logically established, what other previous knowledge that lesson is linked to, and prepares students for what comes next in terms of new lessons.

Source: Elaborated by the authors (2020)

#### 4.1. Digital Storytelling

Storytelling (Zhang and Lugmayr, 2019) is an expression that means the act of telling stories. The practice of storytelling is one of the oldest activities of mankind. Stories are a method of sharing information, knowledge, and values. With the advent of the computer, the Internet, and new digital tools, narratives had to adapt to the technological environment in order to continue sharing this knowledge.

Storytelling is gaining ground in education, especially in distance learning modalities and blended learning (a method that alternates face-to-face moments and activities in virtual environments), given its teaching and potential learning (Wu and Chen, 2020). When telling a story, we aim to organize our experiences and a plot that explains and orders it. In that sense, storytelling can be conceived as a tool capable of managing experiences in the learning process.

Digital Storytelling (Wu and Chen, 2020) has been defined as associating the ancient art of storytelling with digital technology through a personal look, reconstructing experiences, and reflecting on the chosen theme. Digital Storytelling is a robust methodology, considering that stories have always been a dialectic/conversation between the narrator and the "listeners." These narratives' power consists of having a rhetorical structure, leading to individuals' active participation through questions that pose themselves; therefore, they are an excellent resource for education.

Stories serve to teach, learn, entertain, and inspire; they are not a casual diversion; they reflect a basic but efficient way of giving a logical sense to experiences and knowledge. Storytelling is a way to share real-life or imaginary experiences. Portable computers, smartphones, and tablets are used to access the internet and know at any time and space, enabling the new formation and creative practices. This expansion and development of mobile equipment have enabled remote access to information and communication virtually everywhere. Therefore, the increase in the creation of various mobile devices makes it possible for people to remain online most of the time, providing new ways of relating to knowledge. Therefore, digital educational resources using the Digital Storytelling methodology can be a valuable element in the learning trajectory, both for teachers and students.

This work proposes storytelling based on 5 phases (Table 1) that will compose the story and added to the instructional design development phase: context, conflict, climax, closure, and conclusion. These 5 phases are necessarily part of the same story and are told or guided by a storyteller.

#### **4.1.1. System Usability Scale**

The System Usability Scale (SUS) (Drew et al., 2018) was created by John Brooke in 1986 and allows you to evaluate a wide variety of products services. Thus, the methodology has become a reference for the industry, with several scientific and professional articles published. The method's popularity is due, among other reasons, to the fact that it presents an interesting balance between being scientifically refined and, at the same time, not having a too-long application neither for the user nor the researcher. The method is divided into three pillars:

- Effectiveness: Are users able to complete their goals?
- Efficiency: How much effort and resources are needed for users to complete their goals?
- Satisfaction: Was the user experience satisfactory?

SUS has ten questions, which the user can answer using a Likert scale, ranging from 1 to 5, with 1 being "Strongly disagree" and 5 "Strongly agree." For the analysis of the results, it is necessary to calculate an index. The fundamental questions of SUS can be modified according to their context. Below are these (already adapted) questions:

1. I think I would like to understand this lesson often.
2. I find the lesson unnecessarily complicated.
3. I found the lesson easy to understand.
4. I think I would need help from someone with technical knowledge to understand this lesson.
5. I think the various topics of the lesson are very well integrated.
6. I think the lesson is very inconsistent.
7. I imagine that people will understand this lesson quickly.
8. I found the lesson awkward to understand.
9. I felt confident in understanding the lesson.
10. I needed to learn several new things before I was able to understand the lesson.

It is possible to relate each question to Nielsen's heuristics for a structured assessment. This is the recommendation:

- Ease of learning: 3, 4, 7 and 10;
- Efficiency: 5, 6 and 8;
- Ease to memorize: 2;
- Minimization of errors: 6;
- Satisfaction: 1, 4, 9;

For odd answers (1, 3, 5, 7, 9), subtract 1 from the user's score assigned to the answer. Even answers (2, 4, 6, 8, 10) decrease the user's score from 5(5-x). Then add up all the values for the ten questions and multiply by 2,5.

Table 2: SUS Scores and Descriptions.

Score	Description
<60	Unacceptable
60-69	Ok
70-79	Good
80-89	Excellent
>89	Best possible usability

Source: Elaborated by the authors (2020)

As a mature method, the research community was able to establish benchmarks. Thus, the System Usability Score average is 68 points. According to Table 2, SUS can be calculated according to the user's level of understanding. This same scale can then measure the student's understanding of the teacher's didactic sequence. Therefore, in this work, we propose that this framework be added as a tool used in the instructional design evaluation phase.

## 5. Methodology

Firstly, we will contextualize the environment in which the proposal was evaluated (Vocational and Technological Education – composed by a network of more than 640 campuses across the country), presenting its complexity. This work had as space of exploration, a Brazilian Federal Institute. With the expansion of the Federal Network of Professional, Scientific, and Technological Education<sup>2</sup> in 2008, the teaching practice has been developed in new and broad performance areas. According to their objectives, FIs propose to promote integration between different levels and educational modalities through vertical education. In this sense, there exists the perception that within this restructured, bold, and contemporary institutional model, in addition to the continuous and systematic (re)construction of institutional processes, teaching is also (re)constituted within a complex and diversified scenario.

Following the vision presented in Section 2, in the human condition itself, the most evident in our formative gap, considering that we cannot predict everything all the time. The Federal Network also has the disadvantage of education in its initial preparation process to work with Professional and Technological Education. We are tutored within a disciplinary, content-oriented logic. When challenged by the Integrated Curriculum, omnilateral instruction, legal and conceptual prerogatives of Professional and Technological Education, the need for ongoing education is even greater.

This need is accentuated by the specific nature of Vocational and Technological Education, which has particular requirements, such as a minimally inter and transdisciplinary view, ethical-political awareness

<sup>2</sup> BRAZIL. Law no. 11,892, of December 29, 2008. Establishes the Federal Network for Professional, Scientific, and Technological Education, creates the Federal Institutes of Education, Science, and Technology, and takes other measures. Federal Official Gazette, Section 1, p. 1, 12/30/2008.

of the act of teaching, and understanding that we are education workers who form workers. This reaffirms the idea that Education Institutions should provide students with an omnilateral formation, transforming them into a critical social subject, (re)learn their place in society, and reflexive to analyze their paths, including the formative ways. However, in order to develop in the students this endogenous movement of (trans) formation, given the prerogatives of Professional and Technological Education, the teacher needs to have incorporated in his theoretical-practical trajectory what this means.

FIs have a substantial differential that consists of offering the integrated technical high school curriculum (Costa and Coutinho, 2018). The Integrated Curriculum is part of the conception of a learning organization that aims to provide an education that includes all forms of knowledge produced by human activity. It is a progressive vision of education because it does not separate the knowledge accumulated by humanity in the way of scientific understanding from that acquired by students in their daily cultural and material relations. For this reason, it allows an approach to reality as a whole, allowing a favorable scenario so that everyone can expand their reading about the world and reflect on it to transform it into what they deem necessary. Integrated education aims to provide young people who live from work with a new synthesis between the general and the particular, between the logical and the historical, between theory and practice, between knowledge, work, and culture.

It was within this complex educational scenario that we established our research. Based on the above, this work's evaluation was carried out in a class belonging to the technical high school in informatics at the Federal Institute Farroupilha<sup>3</sup> (IFFar) - Brazil. During the evaluations, 6 professors from different disciplines were separated into two groups (3 professors each): the control group and the application group. The control group was the one that did not have access to the empowered instructional design proposed in this work, and the applied group was the one that developed all its activities based on this proposal. The test class consists of 30 first-year high school students who take the technical course in informatics at IFFar.

The experiments took place during the first academic semester of 2020. Each teacher created 10 audiovisual lessons that addressed the topics related to their subjects. As previously stated, the control group teachers developed the lessons without having any theory or didactic support tool as a basis. In contrast, the teachers in the application group were based on the proposal of this work.

In order to collect students' impressions about the produced audiovisual material, SUS was used. For the application group, SUS was already incorporated into the instructional design framework proposed. For the control group, SUS was applied independently. In this sense, the evaluation of this work is quantitative, based on a case study.

Quantitative research (Sheard, 2018) is a classification of the scientific method that uses different statistical techniques to quantify opinions and information for a given study. It is usually an assessment carried out to understand and emphasize logical reasoning and all the information that can be measured about human experiences. In this type of research, the means of data collection are structured through questionnaires, as well as individual interviews and other resources, with transparent and objective questions that are necessary. In this way, the quantitative assessment is rigorously applied so that

---

<sup>3</sup> <https://www.iffarroupilha.edu.br>

researchers can obtain the required reliability to the results, and the SUS proposal is adequate. SUS was applied to groups that served as a case study.

In addition, case studies are a broad research method on a specific subject, allowing for deepening the knowledge about it and, thus, offer subsidies for further investigations on the same theme. It is also considered empirical research that comprises a comprehensive method, with data collection and analysis.

## 6. Evaluation

This work proposal's significant difference consists of the storytelling script, which serves as a guide for teachers in producing content. In the evaluation, we seek to verify the students' perception regarding the items listed above: ease of learning, efficiency, ease to memorize, minimization of errors, and satisfaction. The Figure 3 shows the average based on the answers from SUS of the 10 lessons carried out by the control group (L1 - L10) and the 10 lessons carried out by the application group (L1-SUS - L10-SUS).

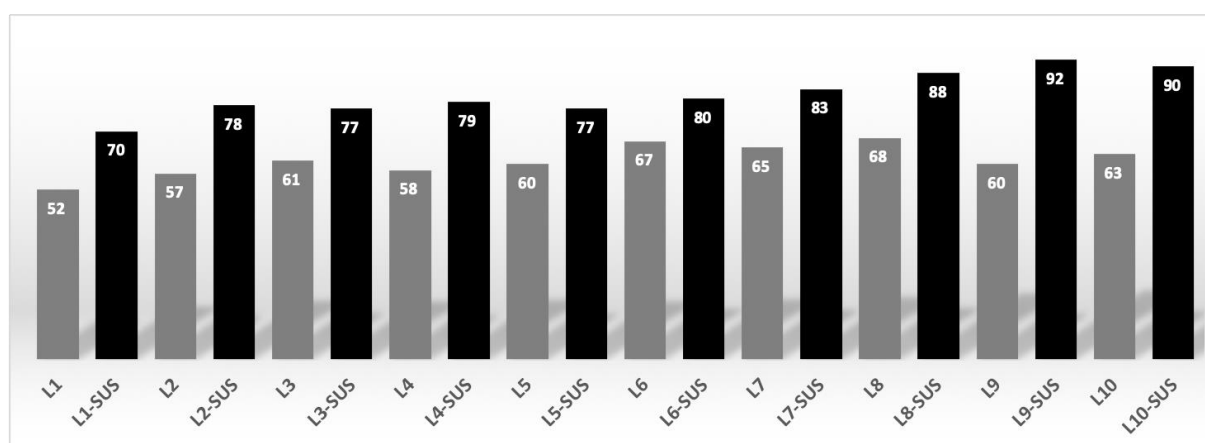


Figure 3: SUS results.

The results show, first of all, that although teachers were not prepared for this exceptional moment that forced them to go from face-to-face to remote teaching, there is a tendency to improve their digital educational products, over time. This is probably due to the fluency that teachers acquire over technologies due to practice and experience. However, even so, we can see that the results, at times, manage to reach an acceptable margin in terms of usability, but that does not go beyond this score and does not remain at that level.

Focusing specifically on the proposed new framework, we can see that this improvement over time is most likely due to the teacher's fluency over time and practice in creating their digital teaching materials. But more importantly, the students' understanding of the lessons shows a significant improvement since the beginning of the remote classes compared to the lessons of the control group.

The evaluations carried out during the first semester of 2020 showed promising results, when the results of applications group was compared with the control group, improving between 15% and 25% in the characteristics evaluated by the students: ease of leaning, efficiency, ease to memorize, minimization of



errors, and satisfaction. According to the Table 2, the improved framework remains between Good and Excellent, while practices without using the framework as a guide remain between Unacceptable and Ok. The Figure 4 shows each of the lessons presented by the application group, the average of the scores for each question answered by SUS. Based on these results, we can filter among those characteristics that SUS evaluates, which significantly impacted students.

It can be noted that individually, the characteristic scored most by students consists of Satisfaction (Questions 1, 4, and 9). This verb refers to fulfilling what is due or promised or meeting demands or expectations. Understanding how students perceive the institution and how they evaluate class is a method to gather different opinions and positive feedback and establish an effective dialogue with the student community and evolve from the criticisms and insights.

Second are the responses that imply greater ease of learning (3, 4, 7, and 10). As can be seen in this study, the simple fact of using audiovisual material is not a guarantee of more accessible learning. In particular, these results show that audiovisual material created based on an instructional framework offers students a better understanding of the lesson due to the requirements imposed by the framework itself, which makes the lesson, in a way, self-contained and thought-provoking.

Third, we have the ease of memorizing the instructional material. In this case, yes, the result is probably the effect of the lesson being in the audiovisual format. Still, one can also claim the same justification as above, which consists of a good organization of the material in order to treat the object studied in the lesson progressively logic.

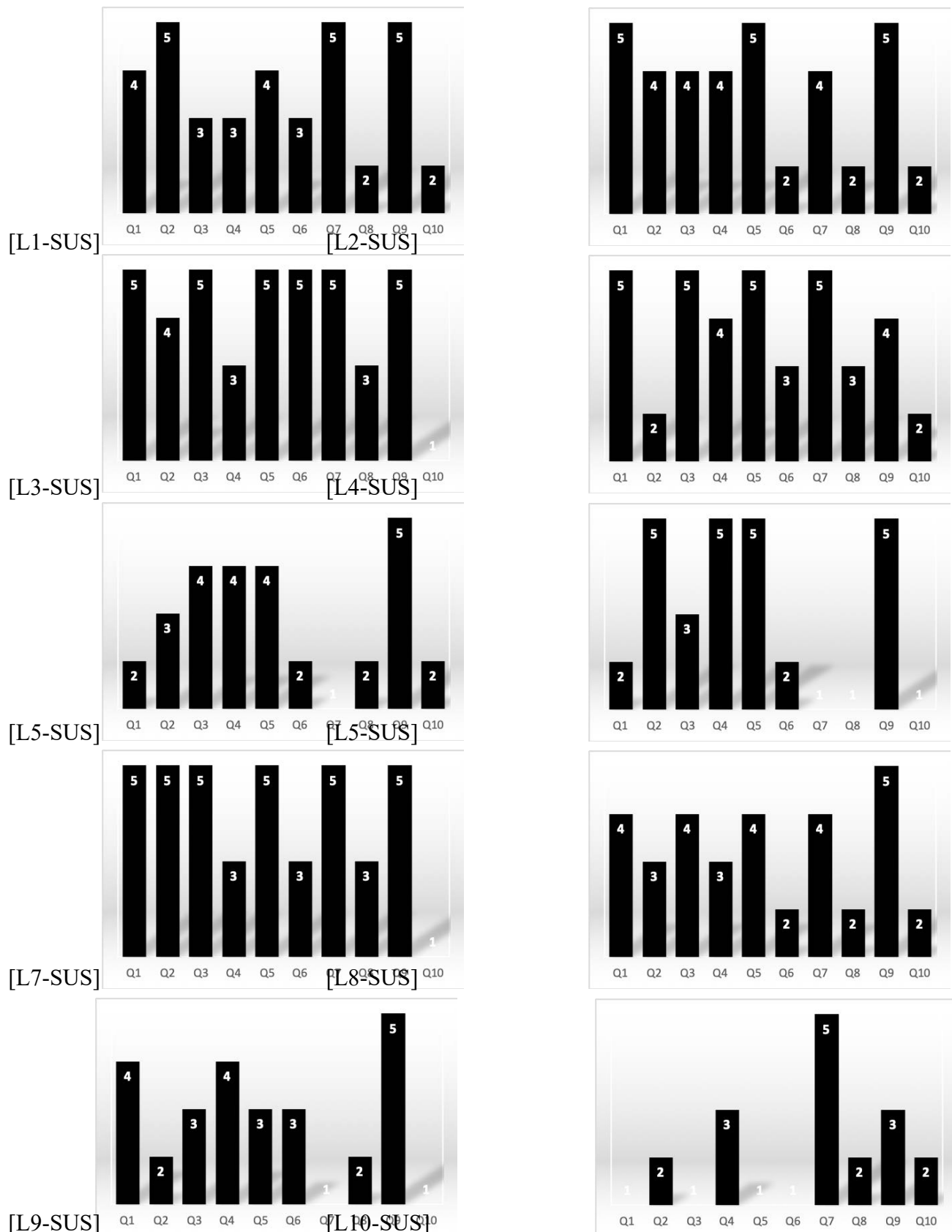


Figure 4: Average responses were made via SUS for each of the 10 lessons in the application group.

## **7. Conclusions**

In the year 2020, the world is paralyzed by a pandemic. A highly contagious and reasonably lethal virus causes an imaginable transformation in society. The COVID-19 pandemic breaks out abruptly to remind us of human frailty. However, even during this chaotic situation, education is necessary. Social isolation measures to reduce contamination are adopted around the world, with greater or lesser rigidity. Almost always, the first institutions reached by these measures are educational ones, environments that keep a large number of individuals confined together for long periods. Educational institutions, mostly in person, had to adapt to remote education quickly.

The change required rapid adaptation on the part of teachers, which raises debates and questions: are teachers prepared to teach beyond the traditional format? To make an excellent remote education curriculum, is it enough to transfer the content of the face-to-face model to the virtual environment? There was no educational or administrative contingency plan for such cases. Many of the educational entities were not technologically or theoretically prepared.

The greatest challenge of this “remote emergency teaching” lies with educators. How to adapt the contents, the classroom dynamics, the lectures, and the evaluations - without jeopardizing the learning process? How to keep students interested and engaged? The task is even more complicated for those who work in areas far from technology or teach children. Therefore, technical support and objective and defined rules for the remote class model format are expected.

Based on this scenario, this work proposes and evaluates a strengthening of the instructional design to create audiovisual material for remote classes. It allows the teacher to quickly and objectively set up and follow a script that goes from the definition of the theme and level of education, passing for the class's development, ending with assessing the student's understanding of that specific lesson.

SUS facilitates and speeds up the evaluation of audiovisual production created by the teacher. But the differential of the proposal is in the logical-didactic organization made possible by storytelling. This is the most significant differential of this proposal. It structures the audiovisual material and is a model that can hold attention, instigate students, as it provides a setting for a context, insertion of a context. This conflict bothers the student, climaxes with a discussion of the proposed conflict, and closing the lesson. The results were promising and validate the applicability of the method.

This proposal was applied in the context of a Brazilian Federal Institute. This imposes an extra complexity in the whole research process since the integration model proposed in the curricula of these institutions, which allows the contextualized approach of the general contents of primary education and the specifics of the desired professional formation, also imposes a more significant challenge to the teaching practice of these institutions. And although all the complexity, both proposals and the application environment in which the work was applied, the results were very promising and positive.

## **8. References**

Al Lily, A.E., Ismail, A.F., Abunasser, F.M., Alhajhoj Alqahtani, R.H., 2020. Distance education as a response to pandemics: Coronavirus and arab culture. *Technology in Society* 63, 101317. doi: <https://doi.org/10.1016/j.techsoc.2020.101317>.

Baticulon, R.E., Alberto, N.R.I., Baron, M.B.C., Mabulay, R.E.C., Rizada, L.G.T., Sy, J.J., Tiu, C.J.S., Clarion, C.A., Reyes, J.C.B., 2020. Barriers to online learning in the time of covid-19: A national survey of medical students in the philippines. medRxiv doi:10.1101/2020.07.16.20155747.

Colao, A., Piscitelli, P., Pulimeno, M., Colazzo, S., Miani, A., Giannini, S., 2020. Rethinking the role of the school after covid-19. *The Lancet Public Health* 5. doi:10.1016/S2468-2667(20)30124-9.

Costa, M.A.A., Coutinho, E.H.L., 2018. Educação Profissional e a Reforma do Ensino: Lei no 13.415/2017. *Educação e Realidade* 43, 1633 – 1652.

Drew, M.R., Falcone, B., Baccus, W.L., 2018. What does the system usability scale (sus) measure? in: Marcus, A., Wang, W. (Eds.), *Design, User Experience, and Usability: Theory and Practice*, Springer International Publishing, Cham. pp. 356–366.

Freire, P., 1996. *Pedagogia da autonomia: Saberes necessários à prática educativa* [Pedagogy of autonomy: Necessary knowledge for educational practice]. Paz e Terra.

Freire, P., 2001. *Política e Educação* [Politics and Education]. 5a ed. São Paulo, Cortez.

Freire, P., 2008. *Educação e mudanças*. [Education and changes] Tradução Moacir Godotti e Lilian Lopes Martin. 31 ed., Rio de Janeiro, Paz e Terra.

Goldman, P.S., van Ijzendoorn, M.H., Sonuga-Barke, E.J.S., 2020. The implications of covid-19 for the care of children living in residential institutions.

*The Lancet Child Adolescent Health* 4, e12. doi: [https://doi.org/10.1016/S2352-4642\(20\)30130-9](https://doi.org/10.1016/S2352-4642(20)30130-9).

Iivari, N., Sharma, S., Ventä-Olkkonen, L., 2020. Digital transformation of everyday life – how covid-19 pandemic transformed the basic education of the young generation and why information management research should care? *International Journal of Information Management*, 102183. doi: <https://doi.org/10.1016/j.ijinfomgt.2020.102183>.

Imbernon, F., 2009. *Formação permanente do professorado: novas tendências* [Permanent teacher preparation: new trends]. São Paulo, Cortez.

Law, L.C., Wong, K.M., 1995. Implications and problems of constructivism for instructional design.

Sheard, J., 2018. Chapter 18 - quantitative data analysis, in: Williamson, K., Johanson, G. (Eds.), *Research Methods* (Second Edition). second edition ed. Chandos Publishing, pp. 429 – 452. doi: <https://doi.org/10.1016/B978-0-08-102220-7.00018-2>.

Sweller, J., Merriënboer, J., Paas, F., 2019. Cognitive architecture and instructional design: 20 years later. *Educational Psychology Review* 31, 261–292.

Tardif, M., 2014. Saberes docentes e formação profissional [Teaching knowledge and professional instruction]. Editora Vozes.

Viner, R.M., Russell, S.J., Croker, H., Packer, J., Ward, J., Stansfield, C., Mytton, O., Bonell, C., Booy, R., 2020. School closure and management practices during coronavirus outbreaks including covid-19: a rapid systematic review. *The Lancet Child Adolescent Health* 4, 397 – 404. doi: [https://doi.org/10.1016/S2352-4642\(20\)30095-X](https://doi.org/10.1016/S2352-4642(20)30095-X).

Wu, J., Chen, D.T.V., 2020. A systematic review of educational digital story- telling. *Computers Education* 147, 103786. doi: <https://doi.org/10.1016/j.compedu.2019.103786>.

Zhang, Y., Lugmayr, A., 2019. Designing a user-centered interactive data- storytelling framework, in: *Proceedings of the 31st Australian Conference on Human-Computer-Interaction*, Association for Computing Machinery, New York, NY, USA. p. 428–432. URL: <https://doi.org/10.1145/3369457.3369507>, doi:10.1145/3369457.3369507.

## **Pandemic and Education: notes from the Brazilian context**

**Lucas Pacheco Brum**

Postgraduate Program Studies in Education, Federal University of Pelotas,  
Pelotas, Rio Grande do Sul, Brazil.

ORCID: <https://orcid.org/0000-0001-7655-8463>

Email: [lukaspachecobrum@yahoo.com](mailto:lukaspachecobrum@yahoo.com)

**Marcos Vinícius Silva Magalhães**

Postgraduate Program Studies in Art, Brasília University,  
Brasília, Federal District, Brazil.

ORCID: <https://orcid.org/0000-0001-7752-5671>

Email: [marvimagalhaes@gmail.com](mailto:marvimagalhaes@gmail.com)

**Cristina Rolim Wolffenbüttel (Corresponding author)**

Postgraduate Program Studies in Education, State University of Rio Grande do Sul,  
Osório, Rio Grande do Sul, Brazil.

ORCID: <https://orcid.org/0000-0002-7204-7292>

Email: [cristina-wolffenbuttel@uergs.edu.br](mailto:cristina-wolffenbuttel@uergs.edu.br)

**Carlos Augusto Pinheiro Souto**

State University of Pará,  
Belém, Pará, Brazil.

Email: [augusto.anasouto@gmail.com](mailto:augusto.anasouto@gmail.com)

**Maria Cecilia Lorea Leite**

Postgraduate Program Studies in Education, Federal University of Pelotas,  
Pelotas, Rio Grande do Sul, Brazil.

ORCID: <https://orcid.org/0000-0002-9197-2299>

Email: [mcilleite@gmail.com](mailto:mcilleite@gmail.com)

### **Abstract**

*This is an essay that addresses issues related to learning and its possible enhancements through the use of technologies. In the year 2020, amid the moment when all of humanity was affected due to the advent of a pandemic, caused by COVID-19, abrupt changes occurred in all instances. Schools did not go unscathed by all the changes that millions of people were affected by. In the present essay, the authors discuss the problems of this pandemic moment, inviting readers to think about the current moment, having at sight the unequal possibilities that have risen by the educational process mediated by technologies and digital medias.*



**Keywords:** Learning; Pandemic; Inequality.

In the hall  
The buzzer rings  
Backpacks being dragged  
Tight hugs  
Smiles that wait  
Endless conversations

In the school's yard  
Blowing wind  
Child singing  
Boy in the swings  
Endless running around

In the classroom  
Windows opening and closing  
A Rolling leaf  
Children getting up  
Classes being dragged  
Endless noise

In recess  
Ball rolling  
Boy kicking it  
Round dancing  
Endless life

“Any day of 200 School Days”, Lucas Pacheco Brum

## **Introduction**

In March 2020 the school carried the joy of a year that was just beginning. In Brazil, the school calendar and school routine were still normal. Hope, renewal and smiles were plastered on the faces of students and teachers for another year that would begin. Students eager to get to know their younger colleagues and also happy to be reunited with friends. Among the corridors and the classrooms: there was laughter, conversation, hugs and welcoming words. The school would once again be a show, whose repertoire would reveal new stories and discoveries, in which children would, for the first time, learn to read and write, and others would be enchanted by the universe of letters, numbers and sciences, a place where girls and boys could build knowledge, new inventions, creations, fabulations and experiments.

The school would then be a place to establish new bonds of memories and affections that were about to be narrated and built. It would become a space for recesses in which the kids run, jump, play ball, talk, scream and make a racket. A school that is alive, a school with feelings, smells, confusion, and, above all, a school that has people. However, at the heart of this narrative there is room for us to understand the new dynamics of affection and learning that still reverberate in life in times of “social isolation”.

From one day to the next we had sudden changes! We didn't have the people, the noises, the conversations, the hugs and the smiles in the school's hallways. It was a lifeless recess. Suspended classes. The world found itself paused. The hugs, kisses and handshakes were interrupted. Physical contact, the desire to be together, group work and circle dance songs were suddenly restricted and even completely forbidden. Schools have been closed worldwide. The classrooms were transferred to the homes and the blackboard was replaced by the screens of computers, tablets, notebooks, cell phones ...

Parents were more observant of their children's routine and teachers had to become participants in a virtual world, activating their profiles on social networks and producing content in different ways. Thus, new bonds were created. Life, in its human and concrete essence, has been paralyzed. People were prevented from leaving their homes, being forced to confinement, in the absence of social contact. Along with this, the dynamics of the family context had to be rethought, and the role of the teacher unfolded into countless other functionalities and competences, causing daily life to present itself in different ways (Nuza, 2020). Even under an adaptation process, fear and uncertainty dominated people and, it seems to us, we had never felt the effects of globalization so much. Capitalism, colonialism and patriarchy have become even more evident, crossing the various sectors of society and placing human relations in instability (Santos, 2020).

In this sense, when talking about “the pedagogical power of the virus”, the professor and head of the Social Studies Center at the University of Coimbra, Boaventura de Sousa Santos (2020) argues how the pandemic that currently plagues the contemporary world can be understood as a metaphor for new learning processes, at the same time that it provokes new questions and concerns that arise. If we observe the order of the facts, the historical and social issues themselves must be rethought. For Santos (2020, p. 6), “the way the pandemic narrative was initially constructed in the Western media made evident the desire to demonize China”. Perhaps the understanding of how the West views the Chinese market's production methods and hygiene habits may have been responsible for tracing a certain origin of the new virus and the establishment of a health catastrophe.

At the end of 2019, in the process of notification to the World Health Organization (WHO), studies pointed out that the occurrence of severe cases of respiratory syndrome, specifically in the city of Wuhan, in Hubei province, China, were the spread of a specific transmitting agent: a new coronavirus, scientifically called SARS-CoV-2. Since its discovery, much has been discussed about its origin, the virus's ability to mutate, as well as how this pathogenic microorganism “migrated” to the human species, highlighting the effects of mass contagion caused by the virus, giving rise, in March 2020, to an outbreak that, later, was declared a

pandemic (Barreto; Rocha, 2020). From that moment on, in May, the world found itself in a new order, rethinking the course of humanity, recognizing that the pandemic was

[...] announced, the virus traveled the world, installed itself in bodies, thousands of people became seriously ill, the health system of rich and poor countries collapsed, deaths multiplied, panic set in, the so celebrated commercial and personal relations have been compromised, borders have resurfaced and the right to come and go has been blocked. Businesses, schools, sports, cultural activities, meetings, human contact, conversations and affections were interrupted. Airports were closed, public transportation stopped, trips and tours were suspended. School activities had to be stopped abruptly. The world closed. (Couto; Couto; Cruz, 2020, p. 204).

The pandemic caused by COVID-19 has been responsible for guiding the new directions of our history, as pointed out by Carlos Fidelis Ponte, a researcher at the History and Health Observatory at Fiocruz, in an article published in April 2020. In this perspective, a new concern was installed, under an uncertain future, in a post-pandemic context, in which “scientific and technological advances are called into question, given the incapacity they reveal in the control of this 'plague' which, due to its lethal effect, ends up generating a sense of panic at the global level” (Morgado; Sousa; Pacheco; 2020, p. 4).

Thus, when observing the natural course of humanity, especially regarding the understanding of how the great pandemics of the 20th century, such as the Spanish flu (1918-1920), affected people's way of life, we will understand that abrupt changes, arising from the different sectors of society, will be more than necessary. For Carlos Fidelis Ponte (2020), as in the last century, times like these help us recognize the importance of the State as a driving force for such changes, seeking to promote the democratization of resources, as well as the systematization of public policies coherent with the everyone's well-being. According to Christian Dunker (2020), professor of psychology at the University of São Paulo (USP), there is a need to reflect on the problems of State intervention in situations like this, evoking disputes on a social and political level.

Throughout this process, which emerged in a totally unexpected way, teachers were urged, quickly and mandatorily, to create ways to develop their teaching proposals, whether in formal or non-formal ways. The scenario of uncertainty has, in turn, become a challenging chaos. In this sense, the discussion presented by this essay deserves attention in line with the time and space in which it was produced, seeking to generate new questions and reflections. However, there is a paradigm that needs to be discussed, in addition to a paradox that presents itself, respectively: how did the pandemic enhance the use of new technologies in education, and, consequently, the inequalities of learning through technologies? How to equate this relationship? How can we highlight the protagonism of our students based on this new reality?

At the heart of these reflections, the present essay did not seek to answer such questions in a categorical way. Nor did it seek to trace an uncompromising thought around these issues. It was also not sought to systematize a discourse or a disparate narrative of reality, as Santos (2020) postulates, care must be taken

because, in times like this, when many experience the same context, intellectual and academic knowledge tend to have as backdrop a dispute of narratives, many of them unaware of the real dynamics and needs.

Therefore, it is understood that empirical data and a set of methodological and conceptual choices are necessary for the subject presented here to be discussed in depth. Thus, the present work is an exercise of reflection and criticality, which put our thinking in motion from our teaching experiences in arts, and how we, teachers, have dealt with our desires and those of our students, in view of the uncertainties of the new challenges ahead. When faced with the current context, new emergency issues arise, and the teaching and learning processes should be rethought.

### **Pandemic and Education: challenges and uncertainties**

The scenario set up by the pandemic of COVID-19 has affected the four corners of the planet in such a way that it has transformed the way we interact with each other, imposing a review of beliefs, attitudes, values and actions of solidarity on everyone. This scenario impacted, simultaneously, the ways people work, which started to be configured according to certain conditions, from remote services to home offices. In this sense, it has also been evident the effects on new buying habits which, due to the rising financial crisis, sought to reconstitute commercial spaces, presenting different alternatives and possibilities to sell and buy products and services via e-commerce.

As a consequence of the great global health crisis, based on problems of all kinds, people were impelled to find and seek almost instant solutions to the current scenario. Doctors, scientists, teachers, businessmen, in short, they all started to exercise different activities at the same time. Furthermore, in the face of the new order that has managed human life, the field of education has been drastically affected by the pandemic, bringing to the fore - even more - the social gaps.

Social isolation, understood as a measure of protection and control of the virus spread levels, has created new ways of working, imposing, as previously discussed, adaptations and flexibilities. Thus, the practices of learning and teaching, both for teachers and students, have been relocated to digital applications apps, texting platforms, social networks, streaming platforms, Google Meet, Zoom, video calls, etc., all available on mobile internet networks. In addition to these possibilities, the creation of virtual classrooms based on virtual learning environments (VLE), the rules of Distance Education (DE) and remote education have been strongly present in times of pandemic. These digital platforms “make this form of work possible in different professional sectors, as in education, with distance teaching activities from basic higher education” (Morgado; Sousa; Pacheco, 2020, p. 1).

However, this modality has been the target of concerns and criticisms at the municipal, state, federal and district levels, as it reinforces the gigantic inequalities in learning and the great discrepancy between the public and private education systems of Basic Education. Russo, Magnan and Soares (2020, p. 9) argue that the “spread of the virus not only increased the inequalities that already exist in this educational system, but also made this situation more evident”.

There was a joint effort by teachers, classroom assistants and scholars to promote training in virtual environments with a view to teacher training. However, it is crucial to consider, initially, the isonomy of digital access. Moreover, it is highly relevant to consider the cultural, socioeconomic and digital capital of students, under penalty of using educational technologies to deepen social inequalities. The initiatives already carried out in several schools in Brazil point to an asymmetry with regard to student access to technologies.

The so-called connectivity aid distributed to some students did not solve the problem of inequality, because it is a palliative measure. No one in the world was prepared for times like these. To treat it superficially is to ignore the social effects of the pandemic. At the same time, the lack of concrete and perennial policies that reverberate after the pandemic ends up showing the inconsequential treatment given to education in Brazil, which was enhanced with COVID-19.

At this moment, there needs to be more reflection/action than action/action. All actions taken at this time must be thought of, not only for the completion of the school year, but as a basic action for a new education. Education systems need to reflect new state policies for education. However, the scenario that appears in pandemic times is exactly the opposite: the actions are based on reports, spreadsheets and other documents that inform society that education at the municipal, state and federal level are working during pandemic times. There is a political need to be accountable to society, even though this is being done poorly.

The present philosophy, therefore, is summarized in the following syllogism: humans can always reinvent themselves because they are creative. The teacher is a creative human being. Therefore, the teacher has to reinvent himself or herself and create ways to continue educating. This syllogism must, however, be treated in a contextual and relational way. Creative reinvention is not an abstract entity, but it is revealed in the relationship established among teachers, students, society and technologies. The creative reinvention of the teacher, highly popular in times of pandemic, in this sense, is relational.

On the other hand, the municipal, state and federal education systems in Brazil face great difficulties to cope deal with the education and learning of students, as they run rush in an attempt to train teachers to use digital technologies, provide internet and cell phones. Teachers are faced with their pedagogical plans without often knowing what content and activities can be better developed and if in fact their students will learn in a meaningful way. Once the physical contact was replaced by the virtual one and the teacher, in a way, who had daily monitoring of the students, was succeeded replaced by the guardians, parents, siblings, grandparents, uncle, and neighbors, with whom children and adolescents now spend most of their time. Under the bias of educational praxis, it is known that the absence of the figure of the teacher may hinder the smooth progress of the learning process.

In the current context, parents have become the “eyes” of teachers in their homes. They also began to organize their study routine and “perform the role of organizing the study time and monitor compliance”. Residences became schools under the regime of the canvases, suddenly the blackboard and the slate

became obsolete. “School enters the living room, the walls dissolve and the teachers are exposed to the eyes of the families” (Saraiva; Traversini; Lockmann, 2020, p. 8).

Complaints are daily and they are perpetuated amid social networks and WhatsApp groups with teachers regarding the massive load of activities and the daily difficulties faced. There are several questions and anxieties: class planning, keeping up, adequate time to develop online classes and the time in front of screens, grading assignments and the systems assigned to them, orientation work, lack of encouragement from students, conversation with parents and guardians, referral and return of activities, participation in virtual pedagogical meetings, recording of videos, audios, video calls in various applications and digital platforms, and etc.

Furthermore virtually answering to school pedagogical coordination and management, parents and students outside of class hours, thus working more hours in a day. As Saraiva, Traversini and Lockmann (2020) argue, after an analysis based on southern mediatic sources that have been in circulation in recent months, teacher exhaustion is noticeable in times of pandemic. According to the authors:

The work extends beyond the workload teachers have been hired for and the they area available during three shifts to answer questions and via WhatsApp. In addition, there is a need to plan activities, send them, whether in digital or physical format, and still have time to receive and grade activities returned by students. (Saraiva; Traversini; Lockmann, 2020, p. 13).

In addition to this tedious work, parents and guardians, for various reasons, are unable to give due attention to their sons and daughters in their school tasks because they work all day or because they have other daily commitments or they can not keep up with what is being taught due to lack of knowledge or understanding. On the other hand, on the opposite side of the screen, there are parents demanding that assignments need to be concluded in due time, even if the school and the group of teachers try their best to meet the demand of the classes (Saraiva; Traversini; Lockmann, 2020).

And yet, teachers in the relentless pursuit of maintaining a bond with the students, create interesting activities so that they remain assiduous to the new routine and the new format of the classes. In addition to all these issues, it is evident that we will face an even bigger problem, specifically, that many are unable to dedicate themselves to classes for several reasons in addition to the social and psychological issues of coping with the disease, uncertainty, and fear from possible contamination, many students and their families do not have internet access, as well as access to mobile devices and computers.

Under the school idleness produced by digital screens, it is necessary to consider that there are a number of teachers who are already familiar with digital technologies and platforms. These “are already digital influencers in teaching and research, making their transmissions online through their channels, platforms or digital social networks” (Couto; Couto; Cruz, 2020, p. 209). But, unfortunately, it is not the majority who are used to screens and their varied resources.



Suddenly, and under the context of social isolation, the unpreparedness of managers, teachers, as well as the families themselves was evident in the relationships established by the processes of remote education and appropriation of technologies. It is necessary to consider that many education professionals do not have training - or perhaps they did not have the opportunity - to develop the skills and competences to handle or engage by digital means. In addition, many pedagogical plans and school curricula do not have a clear proposal which seeks to systematically align the curriculum with technological and digital means.

When considering the difficulties faced, the pedagogical structure of Distance Education (DE), especially from the current context and taking into account the reality of Basic Education, in which thousands of students do not have cell phones, tablets, computers, or others digital devices, and Internet access - via Wi-Fi or mobile data - major problems arise. According to Couto, Couto and Cruz (2020, p. 210), in “Brazil, practically half of the population does not have access to the Internet or has limited and unstable access. Inequalities in Internet access and use in many peripheral urban areas and rural areas reinforce differences marked by social vulnerabilities”. According to data released in May 2020, by the United Nations Children's Fund (UNICEF), in Brazil alone a number of 4.8 million children and adolescents, aged 9 to 17, do not have access to the internet at home. This index corresponds to 17% of all Brazilians in this age group, according to the news released by Mariana Tokarnia, on Agência Brasil's website.

From these indexes and, considering what is experienced in practice, we can recognize that we are immersed in an educational structure that does not benefit everyone (França Filho; Antunes; Couto, 2020; Freitas, 2020). As these authors point out, we suffer from a weakened education, due to the difficulty of access, which increasingly leads to social disparities. According to Luís Carlos de Freitas (2020), Distance Education, conceived as a method of school work that does not recognize different realities, may increase one of the biggest problems that schools faces daily, that is, inequality. In view of the new scenario, the return to the so-called “normality”, in the midst of political, economic, social, cultural and educational spheres, does not reveal itself as an easy task, and the evidences appear to point to fluctuating paths, liable to reformulation, and constant evaluation.

As previously discussed, it is understood that education in virtual environments is not yet a reality for all students, and that the inequality evidenced by these processes is an urgent issue and deserves to be understood - and resolved - in light (of) more systematic study on the subject. In view of these notes, by promoting equality and equity of access to technological means and by paying attention to an education that considers and recognizes the new means of sharing content, especially at school, we will understand democratic processes of teaching and learning.

Thus, if we look at education for the teaching of the arts, for example, we may come across unprecedented learning situations, in which new stimuli and potentialities may be involved. In a process of adaptation - and even survival -, which we are experiencing, the pedagogical processes related to the arts will be able to substantiate practices of reframing and social criticism. Elliot Eisner (2008), when considering the power of creative imagination intermingled with the educational making process, considers that:

Imagination is not a mere ornament, like art. Together they can free us from our tightened habits. They can help us restore a decent purpose to our efforts and create the kind of schools that our children deserve and that our culture needs. Such aspirations, my friends, are stars worth stretching for (Eisner, 2008, p. 16).

Thus, if we observe the migratory path of the classroom towards the content of digital media, we may come across unprecedented pedagogical biases in which the culture and reality of our students circulate in a fluid and complex way, imposing, more and more, the decentralization of knowledge and a reassessment of educational praxis. As discussed, although all the anxieties and needs in facing this “new time” are considered, the appropriation of digital media and content, especially those aimed at the consumption of images, videos and music, for example, can be significant strategies. Virtual learning environments (VLE) and their relationship with social networks may, perhaps, mitigate pedagogical losses in the midst of these processes, as well as stimulate the imagination, the power of creation, and the protagonism of our students.

## **Network Education**

The daily lives of new generations are deeply mediated by virtual social networks. This panorama caused a new paradigm to be configured, emerging new ways of being in society. Information and knowledge, which access was previously a privilege for few, nowadays, with the advent and improvement of the Internet, social networks and highly sophisticated digital applications, has become increasingly horizontal, believable, mobile, and ubiquitous. Virtuality, as well as the access to knowledge and data sharing, has produced more democratic and flexible virtual spaces, in contrast to those found in books, handouts, museums, art galleries, and libraries.

Nowadays, more than before, new changes have populated the discussions around education, in addition to democratic access to the use of new technologies. For Pérez Gómez (2015, p. 18), “information technology has become a means of participation, causing the emergence of an environment that is constantly changing and reconfiguring itself as a result of the very participation that occurs in it”. As evidenced, some questions have reappeared - or, perhaps, have become more evident - since the discovery of a new virus, whose occurrence, from the point of view of Science, was understood as one of the greatest threats to the human species in all of history.

Undoubtedly, virtual spaces have established a new methodological course in contemporary times of social confinement. Social media started to manage, produce, and conduct the subjects' lives, so that the

invaluable contribution that technologies have provided, both as a life support and as a mainstay of relationships, we cannot rule out the possibility that this whole phenomenon will slide into an even more technology-dependent future, both in professional and social terms. (Morgado; Sousa; Pacheco, 2020, p. 5).

Han (2019, p. 42), however, asserts that “this networked human world leads to permanent self-mirroring. The more dense the network is woven, the more deeply a screen is established between the world and the other, the outside”. The author goes on to say that:

The digital retina, this digitally connected skin, turns the world into a screen image and a control screen. In this autoerotic visual space, in this digital interiority, surprise or wonder is not possible. In enjoying it, humans are only still in themselves. (Han, 2019, p. 42).

The number of access to social networks and the use of various social networks and applications apps, as well as the time that has been spent connecting to digital platforms have grown rapidly, although the democratic sense of access and use of the internet is still a urgent issue raised and discussed in the political and social spheres. However, it is necessary to pay attention to the fact that this access does not indicate the consolidation of a sociodigital conscience capable of universalizing learning processes and effectively carrying out didactic transpositions of classroom knowledge into digital ones. We are far from it. However, the pandemic that was installed in the world and forced humanity to reinvent itself brought with it not only the crisis, but the opportunity to exercise autonomy, a greater role and creativity with regard to the search for alternatives capable of meeting needs society, including those related to education.

This universalization of a digital awareness in education, capable of creating daily study routines, discipline and organization of learning between students and teachers, as well as the social awareness of a teaching-learning process based on new technologies is a long way to go. This is because heirs of an extremely face-to-face education, formal, and centered on the figure of the teacher, we were not prepared for this time that imposes new attitudes and constructions of different processes.

Santos (2002) comments that:

Learning a new framework requires changes in values, concepts, ideals and attitudes. The changes that are necessary are not only related to diversified methodologies, or to the use of new equipment, but specifically to new attitudes towards knowledge and learning in a permanent process, capable of guiding the practice and establishing new values in accordance with the demands of a universalized era that is subject to change. (Santos, 2002, p. 49).

In this sense, it is essential that the educator is, in fact, a facilitator in the teaching-learning process, based on new technologies. Its methodological approaches should make it possible for students to develop for greater protagonism and criticality, as well as an understanding of the need to put themselves assertively in this new era, based on technologies. With this, it is not a matter of understanding new technologies as palliative processes in times of adversity, such as that experienced in the pandemic, but guiding a new world and new times. From this perspective, the pandemic presented us with a new paradigm for education and, at the same time, it showed us that more contentious and technical education was responsible for the

reductionism and deficits in training that prevent greater resistance, coping and new challenges postures at this time.

In addition to these issues, it is necessary to consider the lack of preparation of teachers. In some circumstances, undergraduate courses fail to provide opportunities for professionals to know how to deal with technologies in education, both in the field and in the use of technological and social media, linked to different pedagogical proposals. Attempts to insert technologies and social media in school and in the school curriculum are not recent, there are several documents that guide education in Brazil and that point to the need for the critical use of new technologies. For example, the National Curriculum Guidelines for Elementary and Secondary Education (Brazil, 2018), in addition to the Law of Directives and Bases of National Education (LDB, in portuguese) (Brazil, 1996), already signaled the work with technologies in pedagogical practices in the classroom and in the school curriculum. And, more recently, the National Common Curricular Base (NCCB) (BNCC, in portuguese) (Brazil, 2017), also brings “Digital Culture” among its ten General Competencies. In competence 5 of the NCCB it is recommended:

to understand, use, and create digital information and communication technologies in a critical, meaningful, reflective, and ethical manner in the various social practices including school ones to communicate, access and disseminate information, produce knowledge, solve problems and exercise protagonism and authorship in life personal and collective. (Brazil, 2017, p. 9).

Based on the various official speeches pointed out in this essay, it is necessary to question the practical paths taken for the insertion of the use of technologies in education. We do not have many doubts that in the theoretical and academic fields there are several contributions to this subject, but in the practical field, it seems, little has been done, and certainly there is much to be done. Currently, more than ever, with the pandemic and social isolation, we are obliged to perform our roles, on an emergency basis, using remote education. Along with this, we try to demand, in the midst of the various instances, respect for the democratization of technological resources for all teaching modalities.

On the other hand, educators started a true marathon in search of new technological possibilities for teaching. Although the mastery of these technologies is being built slowly and judiciously, it was from these individual initiatives that society started to perceive technologies as more than entertainment and consumption. Gradually, and based on these assertive individual initiatives, institutions began to seek the valorization and comprehensiveness of these processes. This undoubtedly pointed to a new era, in which new technologies will be a crucial part of the process of human formation. At the same time, it is necessary to consider that the time lapse that has been established may enhance social inequality, considering that there is a great deficit of educational policies that favor access to technologies in education.

Before the COVID-19 pandemic, technologies, with which children, youth, and adults were involved and exercised a certain domain, were presented to them, above all, as forms of entertainment and consumption. Young people and teenagers used the Internet, in their smartphones, tablets, notebooks, usually connected to social networking sites. With regard to education, technology has enabled a greater variety and has

become an extra possibility in classes, contributing to the indication of sites on certain contents and other methodological approaches.

If before technologies the use of computers, cell phones, and other mobile applications were often something that caused fear, and even fear to schools and teachers and school management, for not knowing how to deal with technologies, today we are forced to live and manage our pedagogical practices as well as personal and professional lives from digital screens. It was necessary to have a factor with a high lethality rate to accelerate the use of digital media at school, especially in the ways of conducting education in contemporary times. Couto, Couto and Souza (2020) highlight that:

Amid social isolation, this phenomenon mobilized and stimulated thousands of other teachers, hitherto practically anonymous or with little visibility on the web, to produce their didactic performances online as well. A veritable flood of debates on any topic invades our internet environments and everyone is dedicated to producing and disseminating content for online learning. (Couto; Couto; Cruz, 2020, p. 209).

However, it must be considered that, from the pandemic caused by COVID-19, digital platforms presented themselves as basic foundations for a new education, or, as Pérez Gómez (2015) would say, of education in the digital age. In this way, the epistemological basis of education will need to consider digital platforms not as an option, but fundamentally as a hybrid teaching and learning process, which will combine technologies with face-to-face interactions in the training of students. It is important to emphasize, however, that this hybridity must consider the human being in its entirety. The way we treated digital technologies, prior to the pandemic, considered, in a way, as something that could be dispensed with or, at most, an accessory to some “innovative” pedagogical practice. Now, this permission is no longer appropriate.

Rethinking digital technologies in times of social isolation and post-pandemic means taking a look at a teaching and learning process that contemplates the cognitive, affective, sociological, psychological, critical, and spiritual development of the student. It is no longer a matter of just understanding technology as an appendix to the process, but as a fundamental knowledge for human development. Equally, these are not technological processes to meet the logic of capital, in which the human being is seen as a cog that revolves around profit, and the objectives are centered on the creation of technologies capable of enhancing the dominant/dominated relationship and social categories of the system.

### **Technologies and Education: the post-pandemic legacy**

It is not new for teaching practice to understand - at least theoretically - about the contributions of new technologies to education, not only regarding the new means and procedures, but in the different ways in which knowledge is accessed.

Pérez Gómez (2015), when bringing the issues related to the globalized age, explains to us that this has provided unprecedented access to information and, although this knowledge is accessible in the palm of our

hands, there is a need for conscious relationships to be established, above all as to the critical position in the face of the inexhaustible deposit of information, which is the Internet. According to the author:

[...] it is possible to affirm that the deficit of the new generations, in general, is not due to the lack of information and data, but to the significant and relevant organization of the fragmented and biased information they receive in their spontaneous contacts with multiple screens and several networks (Pérez Gómez, 2015, p. 27).

In addition to these issues, in times when society suffers the effects of a pandemic, news and informational posts point to studies that measure the effects of the crisis from future perspectives. And, of course, there is no doubt about the side effects that, as a society, we will suffer. The report called “Deus me Lives! Intoxication caused by confinement is already a reality”, published by Virtual Época Negócios Magazine, at the end of April 2020, points to the stress generated by the rampant consumption of content. Thus, based on these parameters, it is necessary, in the educational scope, to guide our students towards the conscious consumption of this information.

However, it is worth remembering that, although the challenges arise and education via virtual channels is a strategy, or perhaps it is understood as a way to remedy the “lost” time in face of social isolation, the school, as we know it, cannot be weakened. The school, as well as the teachers, should be valued, being the target of public policies concerned with the investment in research and physical and social structure for the broad access of digital resources. As stated by Alexandre Sayad (2020), the school, more than before, should be valued for being a space for socialization and full socio-emotional development. According to him, the school remains the base, and the world as the backyard for learning.

Thus, considering the daily life and the dialogue produced on the web may substantiate pedagogical work consistent with the fluctuations of society itself. Once again, it is worth considering that the core of the discussions presented by this essay, as evidenced, was not aimed at deepening the scope of public policies in order to develop democratization of resources for public education, for example. The present narrative recognizes this need and treats it as an urgent and primordial issue, thus, the discussions sought to contribute to the teaching mediated by technologies, while taking into account the social impasses experienced by the various people involved in the educational scene in contemporary times.

The use of new technologies and content shared by students on social networks is not a new issue, however, it requires a new positioning. Deconstructing education from its rigid and traditional molds may be responsible for dimensioning new paths and pedagogical strategies closer to the students' reality, recognizing their identities and the different communities.

We started this essay with a toast to Art through a poem that references the life that pulses in schools. If, as mentioned, we find smiles that await us in the hallways, children who sing and kick balls, games and an immense life in school spaces, it is essential that, while also thinking about the possibilities that technology



brings, we also cultivate encounters, closeness, hugs, conversations, and so many wonders and beauties that are present in schools.

## **Acknowledgements**

Eduardo Filipe Albrecht Lassig, Rio Grande do Sul Research Support Foundation (FAPERGS), National Council for Scientific and Technological Development (CNPq).

## **References**

- Barreto, Andreia Cristina Freitas; Rocha, Daniele Santos. (2020). *Covid 19 e educação: resistências, desafios e (im) possibilidades*. Bom Jesus da Lapa, BA: Revista Encantar - Educação, Cultura e Sociedade, v. 2, p. 01 a 11, Jan./ Dec.
- Brasil. (2018). Conselho Nacional de Educação. *Resolução CNE/CEB n.º 3*, November 21, 2018. Atualiza as Diretrizes Curriculares Nacionais para o Ensino Médio. Brasília. Available at: <http://novoensinomedio.mec.gov.br/resources/downloads/pdf/dcnem.pdf>. Consulted: Oct 6, 2020.
- Brasil. (2017). *Base Nacional Comum Curricular*. Brasília: MEC, 2017. Available at: [http://basenacionalcomum.mec.gov.br/images/BNC\\_C\\_20dez\\_site.pdf](http://basenacionalcomum.mec.gov.br/images/BNC_C_20dez_site.pdf). Consulted: July 22, 2020.
- Brasil. (1996). *Lei n.º 9.394*, de 20 de dezembro de 1996. Estabelece as Diretrizes e Bases da Educação Nacional. Available at: [http://www.planalto.gov.br/ccivil\\_03/leis/L9394.htm](http://www.planalto.gov.br/ccivil_03/leis/L9394.htm). Consulted: July 29, 2020.
- Couto, Edvaldo Souza; Couto, Edilece Souza; Cruz, Ingrid de Magalhães Porto. (2020). *#FIQUEEMCASA: EDUCAÇÃO NA PANDEMIA DA COVID-19*. In: Interfaces Científicas. Aracaju, v. 8, nº 3, p. 200 - 217.
- Dunker, Christian Ingo Lenz. (2020). *A arte da quarentena para principiantes*. São Paulo: Boitempo, 2020. E-book. ISBN 978-85-7559-778-1.
- Eisner, Elliot E. (2008). *O que pode a educação aprender das artes sobre a prática da educação?* In: Currículo sem Fronteiras. v.8, n.2, p. 5-17, Jul/ Dec.
- França Filho, Astrogildo Luiz de; Antunes, Charlles da França; Couto, Marcos Antônio Campo. (2020). *Alguns apontamentos para uma crítica da Educação à Distância (EaD) na educação brasileira em tempos de crise*. São Gonçalo, RJ: Revista Tamoios, nº 1, p. 16 - 03, May.
- Freitas, Luís Carlos de. (2020). *EAD, tecnologias e finalidades da educação*. Available at: <https://avaliacaoeducacional.com/2020/04/17/ead-tecnologias-e-finalidades-da-educacao/> Published April 17, 2020. Consulted: May 20.

Han, Byung-Chul. (2019). *A salvação do belo*. Petrópolis, Rio de Janeiro: Vozes.

Morgado, José Carlos; Sousa, Joana; Pacheco, José Augusto. (2020). Transformações educativas em tempos de pandemia: do confinamento social ao isolamento curricular. *Práxis Educativa*, Ponta Grossa, v. 15, p. 01 - 16. Available at: <<https://www.revistas2.uepg.br/index.php/praxiseducativa>>. Consulted: August 28, 2020.

Nuza, Darli. (2020). Educação: descobertas, louça na pia e esperança. *Revista BSBMack*, n.8, Ano 2, p. 31-33, June.

Pérez Gómez, Ángel. I. (2015). *Educação na era digital: a escola educativa*. Porto Alegre: Penso.

Ponte, Carlos Fidelis. (2020). O que uma pandemia pode nos usar? *RADIS: Comunicação e Saúde*, nº. 211, pág. 35, abr.

Russo, Kelly; Magnan, Marie-Odile; Soares, Roberta. (2020). A pandemia que amplia as desigualdades: a Covid-19 e o sistema educativo de Quebec/Canadá. *Práxis Educativa*, Ponta Grossa, v. 15, e 2015915, p. 1-28. Available at: <https://www.revistas2.uepg.br/index.php/praxiseducativa>. Consulted: August 15, 2020.

Santos, Boaventura de Sousa. (2020). *Uma cruel pedagogia do vírus*. São Paulo: Boitempo.

Santos, Selma Ferro. (2002). Processos de desenvolvimento de novas práticas: apropriação e uso de novas tecnologias. In: VICTORIO FILHO, Aldo; MONTEIRO, Solange Castellano Fernandes (Orgs.). *Cultura e conhecimento de professores*. Rio de Janeiro: DP&A.

Saraiva, Karla; Traversini, Clarice; Lockmann, Kamila. (2020). A educação em tempos de COVID-19: ensino remoto e exaustão docente. *Práxis Educativa*, Ponta Grossa, v. 15, e2016289, p. 1-24. Available at: <https://www.revistas2.uepg.br/index.php/praxiseducativa>. Consulted: August 15, 2020.

Sayad, Alexandre. (2020). *Covid e a escola: alguns vitrais se quebraram; favorecer não substituí-los*. Available at: <<https://revistaeducacao.com.br/2020/05/21/covid-escola-sayad/>> Published May 21. Consulted: August 5, 2020.

# **Teaching History and Indigenous Cultures in Basic School Education: Reflections from Field Research**

**Ricardo José Lima Bezerra**

PhD in Education from PUC SP. Adjunct Professor at the University of Pernambuco: Campus Garanhuns.

Professor at Integrated Colleges of Garanhuns AESGA.

[ricardo.bezerra@upe.br](mailto:ricardo.bezerra@upe.br)

**Tatiane Lima de Almeida**

Master in African Cultures, Diaspora and Indigenous Peoples by the University of Pernambuco.

Professor of Public Basic Education in the city of Capoeiras-PE.

[tatianelima1983@hotmail.com](mailto:tatianelima1983@hotmail.com)

## **Abstract**

*This text is the result of reflections on a field research on the teaching of indigenous themes in schools in Capoeiras, in the Agreste of Pernambuco, starting with Law nº 11.645 / 2008 and the indigenous history in the region where the study is inserted. Due to the importance of the study on indigenous peoples, this research aimed to contribute to the dialogues between Anthropology and Education, so that we can think of teaching as a means of social and academic mobilizations for the recognition in the school space of the socio-cultural diversity existing in Pernambuco state.*

**Keywords:** Teaching Indigenous History, History Teaching, Indigenous History and Cultures, Basic School Education, Fundamentals of School Ethnography

## **1. Introduction**

In view of the variety and changes in educational policies in recent years in relation to Brazilian basic education, the teacher is faced with the challenge of making the student experience learning so that he can understand the importance of studying the stories and indigenous cultures. In an attempt to revert the problems of ignorance on this theme, Law no. 11,645/2008, which, amending the 1996 National Education Guidelines and Bases Law, institutes the mandatory teaching of indigenous history and cultures in Brazilian Basic Education, especially in the disciplines of History, Geography, Arts and Literature. Thus, the objective is for students and teachers to overcome the idea of "Indian" closely linked to generic stereotypes produced by common sense and traditional historiography over the centuries, since the colonization of our country.

“Interdisciplinary research, which combine historical and anthropological theories and methods, gradually deconstruct simplistic understandings and misinterpretations about Indians and their relations” says Maria Regina Celestino de Almeida (2010, p. 10-11). Thus, educational research it needs to dialogue

more with these new historical-anthropological studies, allowing the requalification of the initial and continuing training of teachers and the elaboration of new significant pedagogical practices that contribute for the teacher to appropriate and work more and better with the ethnic-racial issues and, in especially with the indigenous theme in basic education. Teaching about indigenous peoples in schools is still deficient, surrounded by preconceived ideas, considering the existing distortions in what is curricularly proposed and what is experienced in the pedagogical practice in the classroom, in dissonance with the new historical and anthropological approaches on Brazilian indigenous people. In the present text, therefore, we seek to contribute to educational discussions on the teaching of indigenous themes in Brazilian basic schooling, pointing out reflections extracted from field research and, at the end, proposing alternatives for continuing teacher education. Evidently, there is an emergence of these discussions, since knowledge about indigenous peoples and rights is in permanent threat in our country, and is also ignored at school, as well as in other social spaces.

This text is the result of reflections on a field research on the teaching of indigenous themes in schools in Capoeiras, in the Agreste of Pernambuco, starting with Law nº 11.645 / 2008 and the indigenous history in the region where the study is inserted. Due to the importance of the study on indigenous peoples, this research aimed to contribute to the dialogues between Anthropology and Education, so that we can think of teaching as a means of social and academic mobilizations for the recognition in the school space of the socio-cultural diversity existing in Pernambuco.

In this sense, this research had as field of study three public schools in the city of Capoeiras / PE. The choice of schools was based on educational indicators such as Ideb , Saepe (Pernambuco's Basic Education Assessment System) and also by the socioeconomic characteristics of the place in which they are inserted. As researchers on the indigenous theme, we seek to change the reality of teaching in school life, so why do it? It is necessary to understand how the teachers of these schools react to the indigenous theme experienced in the teaching-learning process, thus inferring the representations involved in this process. But why do this research in Capoeiras-PE?

The region where the city of Capoeiras is located was part of the colonial trade route during the eighteenth century, having great economic importance at that time. For being part of the Una River basin and all the extension of what was the “ Ararobá Sertão ”. And because we realize that both students and teachers in this region are unaware of this history, especially with regard to the indigenous origins of the various groups that make up the local population.

In the region there are many narratives of memories that enabled us to think about the history of Capoeiras, based on the identities formed in that region. We are faced with narratives of residents, where people are interested in reporting their lives, evoking identities related to family memories, and belonging to the place where they live.

The research aimed to highlight and discuss the narratives and views of teachers of the final years of elementary school in the schools studied, about the histories and cultures of Indigenous peoples in the teaching- learning process. It was also necessary to identify the differences and similarities in the conceptions of the teachers of the researched schools about the plurality and diversity of indigenous peoples in Brazil and the discussions in the teaching of History.

From the daily life and experiences lived in schools during the teaching-learning process, from the

reports of teachers of the disciplines responsible for discussing the indigenous theme in Basic Education, we try to understand what the existing concepts in school education in Capoeiras-PE are about the history and indigenous cultures. What visions and ideas were conveyed in these schools? Moreover, how these conceptions materialized or did not apply the legislation on education for ethnic-racial relations in public education?

We understand that there are several obstacles faced in the process of teaching indigenous themes in school education. In addition to the absence of adequate didactic material, there is also the fact that traditional historiography contributed to devalue the protagonism of the Indigenous in the History of Brazil. Add to all that, the teachers' lack of preparation in relation to knowledge about the stories of Brazilian indigenous peoples. On the inhabitants before the arrival of the colonizers, as well as on the original peoples still present in contemporary times, there is an ignorance and a repetition of old pedagogical practices, making the study of indigenous themes in schools inadequate. Obviously, most teachers are unaware of recent historical and anthropological studies on the indigenous theme, as they did not have the necessary contact with these studies in their initial training or in continuing training, which, in our view, is one of the main obstacles to the teaching of children. Indigenous histories and cultures, making effective what determines Law nº 11.645 / 2008. Collaborating so that the school is an entity at the service of overcoming preconceived models and ideas, contributing to the knowledge of the ethnic and social diversity of our country, as well as valuing and respecting that same diversity, are objectives pursued by us teachers and researchers of this theme, because agreeing with Aracy Lopes da Silva,

The main intention is to inform correctly; opening paths for understanding the wisdom, peculiarities and wealth present in indigenous societies; raise awareness of the dramatic situation that these peoples have faced throughout history; indicate the possibility of forms of symmetrical relationship between Indians and “whites”; inform about rights, demands and indigenous social movements in Brazil today, indicating how they are part of a broader movement, close to the Brazilian society of our time (SILVA, 1987, p.132).

## **2. Ethnographic research: field and subjects**

The municipality of Capoeiras is located in the interior of Pernambuco, in the Agreste Region, approximately 224 km away from Recife, the state capital, bordering the municipalities of São Bento do Una, Jucati, Caetés and Pesqueira.



Capoeiras Municipality Location

Source: [www.wikipedia.org.com.br](http://www.wikipedia.org.com.br)

The municipality spans 336.3 km<sup>2</sup> and had 19,593 inhabitants in the last Census. The demographic density is 58.3 inhabitants per km<sup>2</sup> in the territory of the municipality. Capoeiras is known for its cheese production and for having one of the largest cattle fairs in the state. The municipality has 3 (three) quilombola communities recognized Imbé, Cascavel and Fidelão, with great cultural diversity such as Reisado and traditional June groups. The option of schools in the municipality of Capoeiras as an empirical field arose because the location is full of memories that refer to an indigenous past. This information inspired us to understand why these memories were restricted to family conversations and unknown to most people who live in the area. Another reason is the proximity to municipalities with the indigenous peoples living in Pesqueira such as the Xukuru do Ororubá and the Xukuru at Cimbres and in Águas Belas, the Fulni-ô people. And this information is unknown to a large part of the population and to teachers, as verified by the interviews conducted, and thus, little discussed in school spaces.

The research carried out intended to contribute to the discussions in the academic environment on the teaching of indigenous themes in schools. But, above all, to expand these discussions to other spaces, above all, because we understand that it is important to recognize the importance of teaching about indigenous peoples in school spaces, as a way of valuing these cultures, recognizing that the ethnic diversity and culture of our country is one of its most emblematic features.

Even though Capoeiras does not currently have any indigenous ethnic groups in its territory, the proximity of municipalities to indigenous territories is very large. Thus, we realize that the distance is not in the kilometers between one municipality and another, but in the lack of knowledge regarding the historical and cultural diversity of these Indian populations, close to the municipality of Capoeiras, in Pernambuco.

We understand the importance of teaching History and indigenous cultures in school spaces, in all teaching modalities, contributing with respect for ethnic-cultural diversity and socio-cultural differences. We assume that the school plays an extremely important role in the formation of society in mobilizations against prejudice and ethnic-cultural discrimination, as well as in the preparation of children and young people for life in society, based on the values of ethics, responsibility and citizenship.

### **3. See, hear and write: a school ethnography in public schools.**

The research that originated this text sought to observe the daily teaching practices of teachers, in relation to the teaching of history and indigenous cultures, and whether Law No. 11,645 / 2008 was experienced in schools in the academic year of 2019. During our stay in the field we realized that just observing teaching practices would not be enough, requiring a deeper analysis in the official documents used by the schools and a comparison between what was planned and what was experienced.

We are faced with a total lack of knowledge of teachers with regard to Law No. 11,645 / 2008 and the importance of indigenous themes. In all the schools surveyed, the Indian was seen only as the character of the 20th of April, a commemorative date experienced by elementary school teachers in the early years, with activities attributing characteristics that do not include indigenous peoples in our country, reinforcing



stereotypes and prejudices built up to the present in school spaces.

In the final years of elementary school, the Indian appears in the contents covered in the textbook as the one who was acculturated, mestizo, now good, now wild. Even among History teachers, we realize that there is no concern in presenting other didactic subsidies contemplating an indigenous history, where the Indian is the protagonist of History. To value the history, cultures and characteristics among the different indigenous peoples. During our stay in the field, the difficulties and challenges that the indigenous theme faces in school spaces were evidenced, both with regard to the implementation of the Law, as well as the teachers' disinterest in valuing the histories and cultures of indigenous peoples.

We consider that the lack of knowledge of the content of the Law is a serious problem, but also the lack of preparation and training in the academic process and in continuing education, is an obstacle to be overcome, by the bodies responsible for Basic Education, and that the indigenous does not be treated as a folkloric character in History taught in school spaces.

During the period that we were in the field, there was no pedagogical activity related to the indigenous theme in which the teachers evidenced indigenous cultures. Alternatively, on topics such as prejudice, cultural diversity, with indigenous cultures as an example.

Unlike teachers in the early years who used notebooks for daily scripts, in the final years the documentary analysis was centered on class diaries, where teachers register classes and semiannual plans daily. We analyzed the class diaries of some History, Arts and Portuguese Language teachers chosen at random.

When observing the diaries of History teachers, we found that the indigenous appears in the suggested contents, as they are organized in the textbooks, we did not find any suggestion of extra content or activity that contemplated the theme. In the teachers' daily records, we observed that the teaching resources used were basically the textbook and some internet activities.

We identified a total absence of content that contemplated the richness of indigenous stories and cultures. What happened was the reproduction of contents that continue to perpetuate the valorization of a Europeanized history, where the heroes left the "old world" and brought civilization to those people who lived in "barbarism".

In this sense, we realize that there is no concern to seek differentiated activities so that the teaching of indigenous themes is, in fact, an effective teaching process. Valuing the richness and diversity of material and immaterial cultures of these peoples.

We also analyzed the Pernambuco Curriculum published in 2019, as it is the official document followed by the education network, serving as a basis for preparing pedagogical plans. In a superficial analysis of the document produced by the Secretariat of Education of Pernambuco, we observed that it mentions law nº 11.645 / 2008 with regard to the teaching of indigenous histories and cultures to be taught in schools. Although superficially, the indigenous theme appears in some themes and skills proposed by the curriculum.

We consider that the indigenous theme, even contemplated by the curriculum renewed each period, followed the pattern of history that favors the colonizer without evidencing the role that indigenous peoples deserve.

We also seek to identify Law 11.645 / 2008 and suggestions on indigenous thematic teaching, in the

new National Common Curricular Base (BNCC) for Elementary Education, published in December 2017 by the Federal Government to be followed by all Brazilian schools, throughout National territory. This document is still the subject of many discussions among education experts, academics and politicians.

We seek to identify, in the text of the current BNCC, reference to Law 11.645 / 2008 as a proposal for studies and pedagogical and curricular practices on the indigenous theme. However, no reference to the law was found. In the skills proposed by the document, for example, indigenous peoples are mentioned among other contents in a purely chronological sequence, keeping the indigenous as being enslaved, mestizo and acculturated, valuing the history of European "heroes".

Among the pedagogical activities carried out in the schools of Capoeiras-PE analyzed, we did not find any with an indigenous theme produced by the schools, or by the teachers. In the practices observed, the indigenous theme appears superficial in relation to other themes that make up the curriculum in the education network. In other words, in elementary school, final years, the indigenous theme is not experienced, as we understand it should be. The Indian remains forgotten or remains that folkloric character, presented with stereotypes that have no importance in the history of Brazil, eventually remembered on the day of the Indian.

The pedagogical proposals used by the municipality were analyzed, and what we found were outdated guidelines with more than 10 years of formulations, not considering the current context of schools, the diversity of its target audience, nor the debate and recent reflections on school education. the last few years in our country.

#### **4. Proposing an intervention: a possibility of continuing teacher training for work with indigenous themes**

Although Law no. 11,645/2008 enable pedagogical practices for valuing and promoting ethnic-racial diversity, as a way of overcoming prejudices and ignorance about the Indians, we find many deficiencies in the initial training during the degree and the absence of guidelines and programs for teacher training for work with this theme in basic education. Beside these aspects, it is frequent the affirmation among school teachers the limitation to the access to specific didactic subsidies for the study and teaching of indigenous stories and cultures, constituting themselves (in the understanding of these teachers, as we can register during this research) obstacles to the pedagogical work of ethnic-racial issues in Basic Education.

In our research, we observed that the majority of teachers, specifically those who teach History, are not prepared to address the theme of Brazilian ethnic diversity and to deal with indigenous history and cultures, with students in schools. In this sense, below, this proposal for continuing education for teachers aims to contribute to the teaching process on indigenous issues in a perspective more aligned with some recent didactic innovations and paradigmatic changes about the Brazilian indigenous populations allowed by the new historiography indigenous and anthropological studies. We propose that teachers can be adequately trained on the theme and, thus, we guide the following, a sequence of didactic-pedagogical activities aiming to expand the teacher training for the school experience of the indigenous theme in elementary school.

#### 4.1 Didactic Activities Script

THEME: History teacher training: Law 11.645 / 2008 and the teaching of Indigenous themes. TIME PERIOD: 2 semester meetings TARGET AUDIENCE: History Teachers

GENERAL OBJECTIVE: To train History teachers in municipal education networks on indigenous histories and cultures, so that the school is a space for overcoming prejudices, and where indigenous people can be recognized as protagonists of History and are no longer seen as folkloric characters .

**SPECIFIC OBJECTIVES:**

- Know the content of Law No. 11,645/2008;
- Recognize the role of indigenous peoples in the history of Brazil.
- Understand the importance of studying the theme for the appreciation and respect for indigenous peoples. Valuing the histories and cultures of each indigenous people living in Brazil.
- ♦ Contribute to new pedagogical practices on indigenous themes in the classroom. 1st MEETING Theme: Law nº 11.645 / 2008 and the history of indigenous protagonists Time: 1st semester (8 hours)

**CONTENTS TO BE WORKED:**

- Law No. 11,645 / 2008
- Indigenous and indigenist
- movements Indigenous history
- Indigenous people in the Northeast Indigenous protagonists

**Necessary resources:** texts, copy of the Law and data show.

**Methodology:** In groups, reading and studying the text of the Law that is available on the internet ([www.senado.gov.br](http://www.senado.gov.br)). It is important that teachers have access to the content of the Law so that they can understand the importance of it and thus understand how the Law can be applied in schools. One should also use the texts made available by researchers who discuss the history not presented in textbooks on indigenous peoples. Discuss how the Law was created, what the current situation is, and why it is so urgent that teachers and students discuss this topic. And so to implement the Law that aims to value and respect indigenous peoples. And through the knowledge of texts that emphasize indigenous protagonists in our history, the objective is to give greater visibility and importance to indigenous peoples.

**DYNAMICS USED:** The trainer will use the Law as a basis and, through reading and studying it, ask what the group understands after reading. It is important to highlight that the Law came after the social mobilizations of indigenous and indigenous peoples. Another important point will be to emphasize that after a decade of publication of the Law, the lack of knowledge in school spaces is still great, making it difficult to implement it. Various academic texts available will be used in these suggested discussions. After reading and studying the suggested texts, the trainer should ask the teachers about the importance of the Law for teaching indigenous themes in the classroom. And he will ask the big group to form small groups where each group, point out excerpts from the texts read with emphasis on the indigenous protagonists in history and that even the moments of reading were unknown by the teachers.

**SUGGESTED TEXTS:**

- Link: [http://www.planalto.gov.br/ccivil\\_03/\\_Ato2007-2010/2008/Lei/L11645.htm](http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2008/Lei/L11645.htm)

- Indigenous peoples and Law no. 11,645: (in) visibilities in the teaching of Brazilian history by Juliana Schineider Medeiros.
- The Brazilian Indian: what you need to know about the indigenous peoples in Brazil today by Gersem Baniwa .
- An ethnology of "mixed Indians"? Colonial situation, territorialization and cultural flows of João Pacheco de Oliveira.

[http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0104-93131998000100003](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-93131998000100003)

2nd THEME MEETING: Pedagogical practices in teaching indigenous stories and cultures. TIME: 2nd semester (8 hours)

#### CONTENTS TO BE WORKED:

- History teaching
- The indigenous theme in the classroom
- Didactics and pedagogical practices

**METHODOLOGY:** The trainer will initially make a dynamic with the whole group, suggesting that each teacher draw an image representing the Indian. Then you will discuss each image produced. This activity is important to understand the image that each person has about indigenous peoples. From the presentations of the images, stereotyped built on the Indian. Soon after, organize groups, deliver supporting texts and suggest that each group develop a class that has the indigenous theme as its central theme. The suggested texts will serve as a theoretical basis for teachers on the teaching of history. Then each group will present their class to the large group and the trainer will evaluate each presentation, contributing with criticisms that enable teachers to understand the importance of teaching indigenous themes in the classroom. The trainer will conclude with an analysis of the practices used in the pedagogical process.

#### SUGGESTED TEXTS

- A temática Indígena na sala de aula: reflexões para o ensino a partir da Lei 11.645/2008 de Edson Silva e Maria da Penha Silva.
- Povos indígenas: história, culturas e o ensino a partir da lei 11.645 de Edson Silva.
  - O ensino de história indígena de Giovani José da Silva/Luisa Tombini Wittmann.
- Ensino de história e culturas indígenas na Educação Básica: alguns apontamentos para reflexão de Tatiane Lima de Almeida e Ricardo José Lima Bezerra.

#### SITE SUGGESTIONS:

- Nova Cartografia Social [www.novacartografiasocial.com.br](http://www.novacartografiasocial.com.br)
- Índio online [www.indiosonline.net](http://www.indiosonline.net)
- Remdipe [www.indigenascontracovidpe.com](http://www.indigenascontracovidpe.com)
- Instituto Socioambiental [www.socioambiental.org](http://www.socioambiental.org)
- Povos Indígenas no Brasil [www.povosindigenas.org.br](http://www.povosindigenas.org.br)
- Nova Escola [www.novaescola.org.br](http://www.novaescola.org.br)

- Carta Educação [www.cartacapital.com.br/educacao](http://www.cartacapital.com.br/educacao)
- Escola Digital [www.escoladigital.org.br](http://www.escoladigital.org.br)
- Índios no Nordeste [www.indiosnonordeste.com.br](http://www.indiosnonordeste.com.br)

## 5. Final considerations

Especialmente a partir da experiência de pesquisar esses assuntos como algo inovador para nós e também que o contato com o estudo do tema indígena no ensino de História abriu horizontes para pensar, tanto para pesquisadores, quanto para nossa contribuição social e profissional. Para uma educação mais inclusiva, mais crítica, valorizando a diversidade sociocultural e as relações interétnicas em uma região, como o Nordeste Agreste e Sertão, historicamente marcada por exclusão e desigualdades.

Reafirmamos que a pesquisa nessa área deve continuar, a fim de intervir na realidade e criar mais escolas críticas e abertas, compreendendo que não há uniformidade étnica e social, já que a beleza da sociedade brasileira reside na existência e no reconhecimento de sua diversidade racial e social.

E o estudo e a aplicabilidade desse tema na educação escolar abre portas para a sociedade ser cada vez mais plural, democrática e complexa. A Lei nº 11.645/2008, que tem mais de dez anos de vigência, não é apenas um marco legal importante, é um instrumento de intervenção social que possibilita a expansão e o reconhecimento da diversidade brasileira.

## 6. References

- ALMEIDA, Maria Regina Celestino. **Os índios na História do Brasil**. Rio de Janeiro: FGV, 2010.
- ALMEIDA, T. L. de; BEZERRA, R. J.L. **Ensino de História e Culturas indígenas na Educação Básica: alguns apontamentos para reflexão**. In: LIMA, Marta Margarida Andrade; FREITAS, Vera Lúcia Chalegre de; SILVA, Leila Nascimento da; (orgs). *Aprender Ensinado, Ensinar Aprendendo: diálogos entre formação, saberes e práticas docentes*. Curitiba: Editora CRV, 2018.
- BANIWA, G. dos S. **O índio brasileiro: o que você precisa saber sobre os povos indígenas no Brasil de hoje**. Brasília: MEC/SECAD/ Museu Nacional-UFRJ, 2006.
- CAIMI, F. E.. **A História na Base Nacional Comum Curricular: pluralismo de ideias ou guerra de narrativas?** Revista do Lhiste, Porto Alegre, num.4, vol.3, jan/jun. 2016.
- DANTAS, Beatriz G.; SAMPAIO, José Augusto L.; CARVALHO, Maria do Rosário G. de. **Os povos Indígenas no Nordeste Brasileiro**. In: CUNHA, M. C da (orga.). *História dos Índios no Brasil*. São Paulo: Cia das Letras, Secretaria Municipal de Cultura, FAPESP, 1992. p. 431-456.
- LIMA, Maria Margarida de Andrade. **Identidades, Diferenças e Diversidade: entre discursos e práticas educacionais**. In: ANDRADE, Juliana Alves de; SILVA, Tarcísio Augusto Alves da; (orgs). *O ensino da temática indígena: Subsídios didáticos para o estudo da diversidade indígena*. Recife, Edições Rascunhos, 2016. p. 99-109.
- MEDEIROS, Juliana Schineider. **Povos indígenas e a Lei nº. 11.645: (in)visibilidades no ensino da história do Brasil**. In: BERGAMASHI, Maria Aparecida; ZEN, Maria Isabel Habckost Dalla; XAVIER, Maria Luísa Merino de Freitas, (orgs) *Povos Indígenas & Educação*. Porto Alegre: editora Mediação, 2012. p. 49-

62.

OLIVEIRA, J. P. de (org.) **A viagem de volta: etnicidade, política e reelaboração cultural no Nordeste indígena**. 2.ed. Rio de Janeiro: Contracapa, 2004.

PIMENTEL, Spensy. **O índio que mora na nossa cabeça: sobre as dificuldades para entender os povos indígenas**. São Paulo, Prumo, 2012.

SILVA, A. L. da (orga.). **A questão indígena na sala de aula: subsídios para professores de 1º e 2º graus**. São Paulo: Brasiliense, 1987.

SILVA, Edson H. **Povos indígenas: história, culturas e o ensino a partir da lei 11.645**. In: Revista Historien UPE/Petrolina, v. 7, p. 39-49, 2012.

SILVA, Edson H; SILVA, Maria da Penha. **A temática Indígena na sala de aula: reflexões para o ensino a partir da Lei 11.645/2008**. Recife, 2ª edição, UFPE, 2016.

SILVA, Maria da Penha. **A Temática Indígena no Currículo escolar à luz da lei 11.645/2008**. Caderno de Pesquisa, São Luís, v. 17, n. 2, maio/ago. 2010, p. 39-47.

WITTMANN, Luisa Tombini (Org.). **Ensino (d)e História Indígena**. Belo Horizonte: Autêntica, 2015.

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).



# **Exploring University Students' Perceptions of Plagiarism: A Focus Group Study**

**Lokesh Ramnath Maharajh (Corresponding author)**

Senior Lecturer, School of Education, University of KwaZulu-Natal,  
Durban, South Africa.

Email: [maharajhlr@ukzn.ac.za](mailto:maharajhlr@ukzn.ac.za)

## **Abstract**

*Plagiarism is a matter of great concern to those who teach in higher education. The increase in technology has resulted in plagiarism becoming a source of anxiety for many students. Universities are continually being called upon to devote more time and resources to combating plagiarism. However, what of their understanding of students' attitudes towards and understandings of plagiarism? It is critical to understand student perceptions towards plagiarism to develop approaches to combat plagiarism. This paper reports on a focus group study that generated qualitative data on students' perceptions of plagiarism. Informal group discussions were held with first-year students to show how plagiarism appears from the undergraduate student's perspective. An interview schedule was developed to provide an overall direction for the discussion. The schedule followed a semi-structured, open-ended format to enable participants to set their agenda. The analysis revealed that students lack understanding of plagiarism, have certain assumptions about plagiarism, and have negative attitudes towards assigned tasks. This paper argues that there is merit in understanding students' perspectives regarding plagiarism to develop successful strategies to promote academic integrity and prevent plagiarism. The paper concludes with a recommendation that lecturers at tertiary institutions need to teach explicitly plagiarism, how to avoid it, and referencing.*

**Keywords:** plagiarism, reference, focus group, undergraduate students

## **1. Introduction**

Plagiarism is a global challenge in most academic institutions (Khoza & Mpungose, 2017; Mohamed, Abdul Samat, Abd Aziz, Mohd Noor & Ismail, 2018; Mahabeer & Pirtheepal, 2019). It is no secret that plagiarism has become a widespread practice among university students (Curtis & Vardanega, 2016; Nelson, James, Miles, Morrell & Sledge, 2017). For decades, students have been taking ideas and work from others and passing it off as their own. Park (2003) and Smart and Gaston (2019) state that mounting evidence proves that student plagiarism has become increasingly common worldwide. Tertiary institutions worldwide aim to produce highly skilled and competent graduates and honest and ethical professionals (Ramzan et al., 2012). Yet, today more students are engaging in the act of taking the work of others without acknowledgment. Gullifer and Tyson (2010, p. 463) state, "universities need to devote increasing time and

resources to combating plagiarism”. One way of addressing this problem is by understanding the reasons why students plagiarise.

Gullifer and Tyson (2010) state that from a psychological perspective, modifying someone’s behaviour or attitude is essential to gain a good understanding of that person’s perception of the problem. The purpose of this study was to explore university students’ perceptions of plagiarism. Learners at school are generally unaware of plagiarism’s challenges (Chu, Hu, & Ng, 2020). Secondary school learners have been known to use copy-paste (Nwosu & Chukwuere, 2020). Schools are not generally tasked with teaching students about plagiarism. There is a difference in the “literacy and epistemological understanding” (Hendricks & Quinn, 2000, p. 448) between schools and universities. Schools are characterised by “heavy reliance on textbooks” and “rote learning” (Hendricks & Quinn, 2000, p. 448). Schools do not make knowledge; universities do. The ethos of the level of education informs and infuses the writing, reading, and knowledge practices. Plagiarism is less of an issue in schools because they do not require students to use existing knowledge to create overtly and clearly their own new knowledge, expressed as different kinds of arguments. However, universities do, so acknowledging others’ work to build knowledge and establish your credible claims is vital.

Upon their arrival at university, students realise that higher education institutions take plagiarism rather seriously. In a study conducted by Khoza (2015), it was found that higher education institutions’ students find it easier to plagiarise if they were not trained to avoid plagiarism at the high school level. Given this, I feel higher education institutions must learn more about their students’ perceptions of plagiarism. This study may help universities develop strategies to promote academic integrity and reduce plagiarism.

In this paper, I present the findings from a focus group discussion on university students’ perceptions of plagiarism. In this study, the critical question is *what are the university students’ perceptions of plagiarism?* The paper is divided into four parts. The first part presents a review of the literature on plagiarism. In this part, I discuss the nature and purpose of plagiarism, plagiarism as a common problem, and how universities deal with plagiarism. I include a discussion of some of the pertinent studies that have been conducted on plagiarism in higher institutions of education. In the second part, I discuss briefly the methodology adopted in the generation of the data. Part three presents a discussion of the data in the form of questions (why do students’ plagiarise, how serious is plagiarism and how easy is it to be caught plagiarising) with the participants’ verbatim responses. The last part of the paper concludes with a recommendation that students at schools and tertiary institutions need to be taught explicitly what plagiarism is, how to avoid it, and referencing.

## **2. Plagiarism in Higher Education**

### ***2.1 The nature of plagiarism***

There is no one agreed-upon definition of plagiarism (Fishman, 2009; Hansen, Stith & Tisdell, 2011). Bouville (2008) maintains that plagiarism has a general meaning of appropriating the words and ideas of

others. Fish & Hura (2013, p. 35) agree when they state that there is a common element across many definitions that plagiarism is “the act of using another author’s work without citation, thus portraying it as one’s work”. The intentionality of the act of plagiarism also needs to be considered in defining plagiarism. Fish and Hura (2013, p. 37) assert that the viewpoint of unintentional plagiarism “often raises the question of whether students should be penalised when they are unaware they have plagiarised”. However, Yeo (2007) asserts that regardless of the intention, unintentional plagiarism is still plagiarism. For this study, plagiarism will be defined as “passing off someone else’s work, whether intentionally or unintentionally, as your own for your benefit” (Carroll, 2007).

## ***2.2 Plagiarism as a common problem***

There are several reasons as to what causes students to plagiarise. Such reasons include failure to understand tasks, attempts to deceive markers (Wilkinson, 2009), the pressure to excel in their studies, the belief that they cannot be caught, and poor time management (Gullifer & Tyson, 2010), laziness (Ismail, 2018; Magubane, 2018) and increased workload (Karasalides & Emvalotis, 2019; Chan, Rahman, & Sanudin 2020). Some scholars maintain that the students who cheat the most are those who party a lot and have active social lives (Straw, 2002; Ferro & Martins, 2016).

Aside from poor time management skills, unintentional plagiarism is another cause of student plagiarism (Joob & Wiwanitkit 2018; Chrysler-Fox & Thomas 2017). Unintentional plagiarism is a debatable issue that results from misunderstanding or confusion rather than a deliberate intention to plagiarise (Bramford & Sergiou, 2005; Das, 2018). Clough (2000) and Selemani, Chawinga, and Dube (2018) assert that students plagiarise unintentionally because they are not aware of how sources should be used within their work. Gullifer and Tyson (2010) found that students at an Australian university were confused about what plagiarism encompassed. These points to the issue of teaching and learning. Hendricks and Quinn (2000) caution that referencing should not be seen only as a technical skill. They assert that referencing goes beyond the conventions of acknowledging the sources. Students who do not know what plagiarism is or how to avoid it are perhaps not taught about referencing in a meaningful way related to knowledge-making as an act. Most lecturers tell students that plagiarism is cheating, and they will be punished. Very few lecturers explain why it is such a problem or how to avoid it in practical and disciplinary ways.

## ***2.3 How universities deal with the problem***

According to Baruchson-Arbib and Yaari (2004), there are four types of academic plagiarism. The first type involves submitting work written by another student. The second involves ‘patch-writing’, where one takes sentences from a source and mixes them with their own words without crediting the source. The third is neglecting to cite the citation and, fourthly, is failing to use quotation marks. University students do not understand that plagiarism constitutes all of these actions (Baruchson-Arbib & Yaari, 2004). For instance, in a study conducted by Dawson and Overfield (2006), it was discovered that students knew that plagiarism was wrong but was not sure what it constituted. They also found that students desired knowledge and good referencing practice to avoid plagiarising. However, a note must be made that students cannot divine from the ether to get this knowledge. The role of the lecturer in providing this knowledge is crucial. Hendriks

and Quinn (2000) advocate for the explicit teaching of referencing as part of the overall curriculum. To this end, Vardi (2012) suggests that referencing may be taught from a plagiarism perspective or through a critical writing approach. In the plagiarism perspective, the emphasis is on avoiding plagiarism and its resultant penalties (Vardi, 2012). The preferred approach is the critical writing approach since “to write critically, students need to engage deeply with and respond to a range of sources to express their own thinking much like the expert writers do” (Vardi, 2012, p. 923).

Power (2009) discovered that students had a good understanding of what plagiarism is. However, they experienced confusion between paraphrasing, quoting, and citing. Mishra and Gautam (2017) state that there will always be confusion between plagiarism and paraphrasing. They discovered that some students believed that copying from various sources and combining constitutes ‘research’ rather than plagiarism. Students experience a lot of confusion and misunderstandings about what it constitutes, resulting in unintentional plagiarism (Howard, 2016). These cases show us that students have a basic understanding of plagiarism. However, there is also a lack of knowledge of the different acts of plagiarism.

The university’s treatment of plagiarism cases is also covered in the literature on plagiarism (Cahyono, 2016; Carroll, 2016; Thomas, (2017) and Chrysler-Fox & Thomas, 2017). According to Clough (2002), plagiarism is treated severely in universities. Universities have different ways of dealing with plagiarism. Clough (2002) explains that in some universities, the penalty for plagiarising is being given a mark of zero for the assignment. Whereas in other universities, the penalties range from withholding the student’s degree to student expulsion.

#### ***2.4 Students’ perceptions of plagiarism***

Fish and Hura (2013), Smith (2017), and Moss, White, and Lee (2018) inform us that the frequency of student plagiarism occurrence is overestimated in universities by students and faculty. In a study conducted by Fish and Hura (2013) at a large urban college, they found that most students admitted that they had never committed plagiarism; however, the students believed that the other students committed plagiarism frequently. Fish and Hura (2013) further argue that it can be problematic as students who overestimate the frequency of plagiarism by other students may see plagiarism as a norm and choose to plagiarise. This is also confirmed by Ismail (2018, p. 200) that if students estimate the incidence of plagiarism among their peers to be relatively high, they may consider plagiarising to be the norm and, therefore, less severe an offense. This incorrect perception of plagiarism can increase student plagiarism, as students will believe that it is acceptable to plagiarise because other students have. Therefore, students should be taught how widespread plagiarism is in their universities to eradicate the over-exaggeration of student plagiarism and avoid such confusion.

Yeo (2007) argues that students, in general, do not regard plagiarism as serious, especially when compared to other acts. Yeo (2007) states that some students do not consider falsifying bibliographies and submitting work done by someone else as serious cheating. Similarly, Gullifer and Tyson (2010, p. 474) found that students believed that unless the plagiarist copied work “wholesale”, the “penalties associated with

plagiarism were perceived to be draconian, while the act of plagiarism itself is not perceived as serious relative to other deviant acts". Although students acknowledge that there are serious consequences to plagiarising, they do not think it is as serious as other things such as crime.

Across the literature, many scholars have found that students have different perceptions about the chances of being caught (Molnar & Kletke, 2012; Brimble, 2016). According to Lathrop and Foss (2000), students plagiarised because there was only a 10% chance of students being caught. Park (2003) argues that students believe that there are more 'pro's' than 'cons' to plagiarising work because there is hardly a chance of getting caught. However, in contrast to the above, Gullifer and Tyson (2010) reported that in their study, students believed that there is a 100% chance of being caught. This, however, was based on various rumours, such as lecturers supposedly knowing the sources very well. They argue that rumours of such influence students' perceptions into believing that they can easily be caught.

### **3. Methodology**

An interpretive paradigm guided this study. This paradigm emphasises an individual's ability to construct meanings of reality (Mack, 2010) and aims to understand these meanings, which influences one's behaviour. It allows the researcher to look at the world through the participants' perceptions and experiences and explore their world by understanding of individuals (Thanh and Thanh, 2015) and their social contexts. The interpretive paradigm was chosen for this study to understand how university students perceive plagiarism at a tertiary institution in KwaZulu-Natal.

The study adopted a qualitative approach. This is because qualitative research involves viewing and gaining insight into a particular world built by individuals' perceptions and beliefs. In qualitative research, researchers view their participants in their natural settings to make sense of the phenomenon in terms of the meanings the individuals have (Denzin and Lincoln, 2000). Myers (2013) asserts that the benefit of qualitative research is that it helps the researcher to view and understand the social and cultural context where decisions and actions take place. This study used a qualitative approach to discover students' perceptions of plagiarism to reveal the meanings of what students believe about plagiarism and why they choose to plagiarise.

This was an exploratory, qualitative study interested in understanding and interpreting students' perceptions of plagiarism. I used focus group interviews with a sampled group of students to generate data to this end. This study was a focus group study that interviewed a select group of undergraduate students at a tertiary institution in KwaZulu-Natal. The participants involved in this study were first-year Bachelor of Education students. There are a few reasons for targeting first-year students. Firstly, these students were already exposed to academic writing in a compulsory foundation of education module. Secondly, university students in the final year of study are less likely to plagiarise (Sims, 1995). Sims elaborates that students in their final years of study have more invested in their study and therefore have more to lose. He also speculates that they have had more practice at writing with sources. Thirdly, first-year university students generally

understand epistemology as “something out there; not as being constructed” (Hendricks & Quinn, 2000, p. 451). Of the 900 first-year students invited to participate in the focus group interview, fifteen positive responses were received. From the fifteen, seven eventually attended the focus group interview. There were five female and two male students. Four students were African, and three students were Indian. Two students were registered for the Foundation/Intermediate (Grades R to 7) programme. The other five students were registered for the Intermediate/Senior (Grades 4 to 9) programme.

Focus group interviews allow for a conversation between the researcher and many participants at the same time to explore people’s perceptions. The focus group interview process allowed me to examine what students think about plagiarism, how they perceive plagiarism, and why they feel that particular way about plagiarism. The focus group students were asked a set of five questions, which were audio-recorded and transcribed.

Credibility, transferability, dependability, and confirmability increase trustworthiness (Guba and Lincoln, 1994). The concept of credibility refers to how the findings reflect the participants’ actual reality and experiences. This was ensured by audio-recording the interviews and transcribing the recordings verbatim. These transcribed results were handed back to the participants to confirm if what they had said during the interviews was correct. This increased the dependability of the study. To improve further the confirmability, I made the research process as transparent as possible. After the data had been analysed and discussed in detail, commonalities were drawn out of the study to make research and results transferable to other contexts.

Durrheim and Wassenaar (2002) suggest that it is vital that all research studies follow the three ethical principles, which are: autonomy (refers to gaining participants consent and voluntary participation), non-maleficence (non-harmful study), and beneficence (who is going to benefit). These three ethical principles worked to ensure the participants' protection and safety and were applied throughout this study's research process. Before conducting the research, the participants’ autonomy was taken into account by gaining permission from the participants to participate in this study. All seven participants had signed a consent form agreeing that their inputs would be audio recorded, that participation in this study was voluntary, and they were at liberty to withdraw from the interview at any point. The participants were also informed about non-maleficence, in which they were ensured that participating in this study would bring no harm to them in any way possible. Participants were also assured that their participation would be kept strictly confidential and that their names or any other aspects revealed in this study would be kept anonymous. It is only once this was made known to the participants that the research commenced.

For the analysis of the data, the transcriptions were read several times to identify content topics. In other words, I looked for similar threads interwoven in the transcripts. After the initial trawl (involving the continued coding of the data until no new categories were found), patterns and commonalities were identified and grouped into themes.



In the next section, I present selected data followed by a theorised discussion.

## 4. Discussion of data

I will discuss the data obtained from the focus group interview in terms of the three research questions:

- Why do students plagiarise?
- How serious is plagiarism?
- How easy is it to be caught plagiarising?

### 4.1 Why do students plagiarise?

According to the participants, one cause of student plagiarism is laziness. Students show a lack of responsibility when it comes to their academic careers. From the interviews, it was discovered that students might be lazy to engage critically in the assignments given to them. The participants said:

*P2: Maybe you are too lazy to think. People are sluggish to go and do research.*

*P5: They make friends with people who have done it before and people who have excelled before, and they take their work.*

From this, we discover that the participants perceive that students, in general, do not like to engage in assignments and become involved in the research of information, but instead choose to plagiarise. The participants also perceive that some students choose not to make an effort at all but rather submit another student's previous assignment as their own. Overall, the participants viewed students' lack of responsibility and work ethic as laziness, which causes them to plagiarise. The issue of laziness as a possible reason for students to plagiarise is confirmed in studies conducted by Ismail (2018), Selemani et al. (2018), and Ayon (2017). In the Selemani et al. (2018) study, 84.9% of the Malawian postgraduate students indicated laziness as a reason to plagiarise.

There is a perception among participants that students are also procrastinators and choose to tackle their tasks closest to the due date. When students do this, they begin to panic at the last minute due to a lack of time and resort to plagiarism. A participant said:

*P1: Maybe you are doing your work at the last minute, like close to your submission date. Then you have to take whatever you have without adequately analysing the information and not writing it in the right way, so you go and put whatever you have and then submit.*

The above shows that there is a perception that students begin to panic when their work is left for the last minute, and this may easily lead to plagiarism. If the student is against the clock in completing a task, they may quickly fail to reference and cite their work properly. When students are more focused on completing the task, they tend to forget academic writing rules and end up committing plagiarism.

The participants also revealed that university students do not know how to reference correctly. The participants could not understand why there are so many different referencing styles and why it is always changing. The students commented that the causes are:

*P7: Not knowing how to reference. They are not learning how to reference correctly.*

*P5: What I do not get about referencing is the APA 1, 2,3,4,5, and 6. I do not know if they have 7, 8 9 now (laughter); it does not make sense because there are so many references changing.*

*P6: I also did not know about those APA somethings.*

The above views are an indication that many of the participants do not know how to reference because they did not learn how to reference correctly. This may lead to a paraphrasing of ideas and words from different sources, without referencing and passing it off as their own. Participants also argued that they do not know what APA referencing is, nor do they understand why the APA styles of referencing are always changing. This changing of the APA reference style further confuses students, leading to a greater misunderstanding of how to reference. This also speaks to the issue of poor teaching and learning. Lecturers are responsible for teaching students when, how, and why to reference. The teaching of referencing should not be seen as a technical skill. Referencing is closely related to knowledge-making in the disciplines.

The participants also specified a lack of an understanding of how to reference. The participants argued that the referencing styles are always changing, which brings about confusion in them. They also noted that some students do not know how to reference correctly and must be taught how to reference correctly. Similarly, the Joint Information Systems Committee (JISC, 2002), in the UK, discovered that “the main cause of minor plagiarism is a lack of understanding of how to cite material from other sources” (Bramford and Sergiou, 2005, p. 20).

The participants had also indicated that another cause of plagiarism at tertiary institutions is that students do not understand the task given to them.

*P5: When you are given work, and you do not understand it, then you will end up plagiarising or taking other people's ideas because you are blank. When you genuinely do not know what to do, you end up taking others' ideas.*

This lack of understanding of the task causes students to plagiarise because they cannot answer the task on their own. Because the student does not understand what to do and because of fear of failing, the student may resort to plagiarism by taking information from various sources and submitting it. This, too, points to the issue of teaching and learning. Hendricks and Quin (2000) found in their study with first-year English Second Language speakers that students could use technical conventions of referencing successfully after being explicitly taught referencing.

One of the participants indicated that yet another cause of plagiarism at tertiary institutions is that the students experience difficulty in academic writing. The student argues that at the primary school level and high school level, they are not taught how to write academically. However, at the tertiary level, one is expected to have the skills to write academically. This unpreparedness causes students to feel stressed, anxious, and overwhelmed; therefore, they resort to plagiarism to cope. The participant pointed out:

*P3: You know, if at university I am going to be taught about academic writing, if I am writing a lot, why not at primary, at the high school level. Why am I just being introduced to it at university? Because it is going to be overwhelming. You know, now I am going to have to write articles, I have to write twelve-page assignments, it is going to be too much, and on top of that, I might not even have the fluency to express myself. But when, you know, you go on the internet, on Google, it's all there, you know, you look at one*

*article, and you say “ah, I couldn’t have said it any better” and when it comes to academic writing, you know because that’s another set of skills on their own. Some students become somewhat difficult, and it goes back to the inconsistencies between tertiary education and our basic education.*

The participant points out here that students are not trained on how to write academically at the basic education level. However, at university, academic writing is required of students. The student points out the inconsistencies and the gap between tertiary and basic education and states that this is why students plagiarise, as they did not acquire the skills needed in tertiary education. Some students have difficulty expressing themselves or their viewpoints in writing; therefore, they resort to going online or to other sources and extract words from there. According to Selemani et al. (2018), 84.9% of the participants in their study indicated that lack of good academic writing skills led them to commit intentionally or unintentionally plagiarism.

#### **4.2 How serious is plagiarism?**

The focus group participants were asked a question of how serious plagiarism is at their tertiary institutions. They revealed that they believed plagiarism is a severe matter at universities. However, they argued that it is only severe if one has to be caught plagiarising. The participants indicated that if one is caught plagiarising an assignment or task, they would have to face the consequences of their actions. However, the participants noted that although they were made aware of the consequences of plagiarising, they had never experienced nor heard of any student facing such harsh consequences. The students commented:

*P2: It is very serious, you can be caught, and you can be penalised. Students in varsity could face disciplinary action or could end up being expelled. It is just that we do not realise how serious it is. It is serious.*

*P3: In my three years in university, I have never heard of an academically excluded person for plagiarising. I have never heard of anyone paying a fine, suspension, or anything, so we might say it is serious, but we have not seen the consequences yet.*

*P5: If a student has plagiarised, the lecturer is giving that student another chance.*

These views above show that the participants believe that there are serious consequences to plagiarising that can essentially harm their academic careers; however, they have not seen or known any student who has had to pay the price of plagiarising. They believe that the university lecturers are lenient on students as they allow students a chance to resubmit their work rather than allowing them to face the severe consequences of plagiarism. Therefore, it could be said plagiarism is taken seriously at the university. However, the consequences are not perceived to be serious as lecturers show leniency to students. The study conducted by Selemani et al. (2018, p. 1) with Malawian postgraduate students found that academics' common sanctions include giving a warning and asking the student to re-write the plagiarised work.

The participants view plagiarism as serious and believe that there are both academic and legal consequences to face if one is caught. However, they had not heard of any student caught and faced these consequences, but instead, they have been let ‘off the hook’ by the lecturer. Participants state that lecturers often give students another chance to rewrite their plagiarised assignment rather than allowing them to face the university’s consequences. In a study done by Kuther (2003), it was found that students believed that ethical

lecturers do not tolerate cheating or plagiarism. However, they felt that lecturers should exercise judgment in handling and acting with compassion and allowing students a second chance to rewrite plagiarised work. Although the participants in my study acknowledge the severe consequences of plagiarism, they appreciate that lecturers provide them with another chance to correct their work rather than allowing them to face such consequences.

#### **4.3 How easy is it to be caught plagiarising?**

The focus group was asked a question on the chances of one getting caught plagiarising. The participants revealed that they believed that the chances of one getting caught plagiarising is very slim and unlikely. One of the reasons is because of the large number of students in a class. One participant commented:

*P6: I think the chances are very slim. I do not believe they have the time to go out and look at every assignment. The volume of students that our lecturers have to cater to because if I am sitting in my office with 300 scripts, there is no way I am going to read through thoroughly through all of them.*

The view above shows us that participants perceive that it is unlikely to be caught plagiarising, especially when large amounts of students are in a class. The participants believe that it is impractical for lecturers to go through all scripts to determine if students have plagiarised, especially when there is a 200-300 student class. The participants believe that lecturers do not have sufficient time to check thoroughly through each assignment to see if they plagiarise.

The focus group revealed that students are unlikely to be caught plagiarising as they are always coming up with new ways to beat the system to avoid being caught. Even with anti-plagiarism programs like Turnitin, students still find a way to cheat their way out. A participant spoke from her experience:

*P4: People were submitting it with weird things like their CVs and job application letters. It is an Education Studies assignment, but you would submit your Physical Sciences practical to Turnitin. Students are smart. They can get away with anything. Students find ways to not be caught.*

The above shows that students have found ways to cheat the system. Rather than submitting their assignment onto Turnitin to get a plagiarism report, students choose to be dishonest and submit other documents so that the percentage of plagiarism would be low.

The participants interviewed revealed that students are unlikely to be caught plagiarising if they change the words in their assignments. The participants point out that if one has to plagiarise and synonymise the text, they would not be caught plagiarising. The participants also indicated that using a “Word Spinner” program, which ultimately changes all the words around and into synonyms in the assignment, would help you plagiarise and get away with it.

*P2: Spin the assignment. Use synonyms. You will never be caught. If you use synonyms and what you call this - word spinner, you never are caught.*

The above shows that students have ways of avoiding being caught for plagiarising. Their manipulative methods are commonly used at the tertiary institution, and, according to the participants, these methods have proven to be successful. Such instances make it difficult for universities to develop strategies to prevent students from plagiarising. Perhaps constant motivation or reminders of the importance of honesty

and good morale from the university may change students towards being upright, ethical, and honest.

My study has shown that students choose to be deceitful by submitting false documents to anti-plagiarism programs such as Turnitin or using programs such as 'Word spinner', so plagiarism cannot be detected. The participants believed that they could get away with it because there are many students in a class, and lecturers do not have the time to go through each script to check for plagiarism. Burnett (2002), as cited by Park (2003), states that the students most likely to cheat are those who believe that the lecturers do not bother to read their assignments thoroughly or closely review their work. This shows that students take the chance of being deceitful and dishonest as a choice as they believe lecturers would not take the time out to check their work to see if students plagiarise.

## **5. Conclusion**

This study aimed to explore students' perceptions of plagiarism at a tertiary institution in KwaZulu-Natal. Focus group interviews were conducted at the tertiary institution to gain information on how students perceive plagiarism.

This paper recommends that students be taught what plagiarism is and how to avoid it. Clough (2000) states to reduce unintentional plagiarism, students should be taught how to reference correctly. This teaching can take place at schools and tertiary institutions.

Khoza (2015) argues that students are more likely to plagiarise because they may not have been taught how to avoid plagiarism at the high school level. He further explains that teachers in schools should prepare students for tertiary education while they are in school by using digital technology (such as Turnitin) to lower the risk of plagiarism in universities. McCabe (2005) asserts that high school students use the internet to "copy and paste" plagiarism and usually get away with it. Teachers usually turn a blind eye towards it, sending the message that it is acceptable. He then argues that high school teachers should promote academic integrity and to reduce opportunities for student cheating. These opportunities include preparing multiples versions of the test, setting essay questions rather than short - answer questions or tests that are less vulnerable to cheating where students interpret the information they gather rather than "copy and paste". Students feel it is acceptable to cheat at the high school level, and teachers ignore it. In turn, students take this perception of "getting away with it" to universities and continue to plagiarise. However, if anti-plagiarism techniques are taught to high school students, it may reduce plagiarism in tertiary institutions.

Tertiary institutions should teach about plagiarism and referencing to first-year students entering university. The main reason students plagiarise at the tertiary institution is that they lack an understanding of plagiarism. I agree with Hendricks and Quinn (2000) that references should not only be taught as a technical skill but should be part of the overall curriculum. Students in the Hendricks and Quinn (2000) study used technical conventions of referencing successfully after being explicitly taught referencing. The teaching of referencing should go beyond the "negative emphasis" to avoid plagiarism (Hendricks & Quinn, 2000:456).

Mphahlele and McKenna (2019, p. 1087) agree universities should focus on “developing students’ academic writing practices” instead of “detecting and punishing plagiarism”.

The participants in my study referred to Turnitin as a tool to detect plagiarism. The university at which this study was conducted uses Turnitin quite extensively. All students (undergraduate and postgraduate) are compelled to submit Turnitin reports with their writing. However, the literature on technological detection tools for plagiarism suggests that these be viewed with some caution. In a study conducted by Ayon (2017) among students and instructors in Lebanon, the participants revealed that Turnitin deters plagiarism but does not inhibit it. Similarly, Mphahlele and McKenna (2019) caution universities not to see Turnitin as a tool to detect and punish plagiarism. Their study recommended that

that in order for text-matching software to be appropriately understood and implemented, significant work needs to be done in the field of academic development to ensure that staff and students understand that plagiarism can be an unintentional act, which requires appropriate development of academic literacies to avoid, and that referencing is a central academic literacy practice emerging from our knowledge-making practices (Mphahlele and McKenna, 2019, p. 1087).

The teaching of referencing should educate students on what plagiarism is, what actions are considered plagiarism, and cite and reference using the correct referencing style. If students were educated on this, unintentional plagiarism would be limited. However, if the student has completed the course and still chooses to plagiarise, they should bear the university's consequences of plagiarism.

I agree with Ismail (2018) that there is a genuine need to increase university students’ understanding of plagiarism and its consequences. Therefore, I recommend in line with Colella-Sandercock and Alahmadi (2015) and Leonard et al. (2015) that it is not enough to alert students of university rules around plagiarism, but that lecturers have conversations with students about plagiarism and its consequences. Lecturers need to find strategies to take a proactive approach to plagiarism. To this end, I borrow from Eaton et al. (2017), who suggest that lecturers include formative feedback in their teaching so that students get opportunities to focus on developing their writing and referencing skills.

Universities should also provide a constant promotion of honesty and academic integrity to students. This form of motivation could subconsciously change students’ negative attitudes and guide them to become honest citizens of the community. Creating a ‘culture of integrity’ may reduce student cheating and establish ‘the value of living in a community of trust’ (McCabe and Trevino, 2002).

I would like to conclude by acknowledging that my study included only seven first-year undergraduate students. Future research should include students from across the year of study as well as postgraduate students and lecturers. This research could also evaluate the effectiveness of anti-plagiarism interventions and prevention strategies.



## 6. References

- Ayon, N. S. (2017). Students' and Instructors' Perceptions of Turnitin: A Plagiarism Deterrent? *Creative Education*, 8, 2091-2108. <http://www.scirp.org/journal/ce>
- Bamford, J., & Sergiou, K. (2005). International students and plagiarism: an analysis of the reasons for plagiarism among international foundation students. *Investigations in university teaching and learning*, 2(2), 17-22.
- Baruchson-Arbib, S., & Yaari, E. (2004). Printed versus Internet plagiarism: A study of students' perception. *International Journal of Information Ethics*, 1(6), 29-35.
- Bouville, M. (2008). Plagiarism: Words and ideas. *Science and Engineering Ethics*, 14(3), 311-322.
- Brimble, M. (2016). Why students cheat: An exploration of the motivators of student academic dishonesty in higher education. *Handbook of academic integrity*, 365.
- Burnett, S. (2002). Dishonor and Distrust: Student Plagiarism is Now as Easy as Pointing and Clicking. *Community College Week*, 8.
- Cahyono, B. Y. (2016). How Australian and Indonesian universities treat plagiarism: A comparative study. *Jurnal Ilmu Pendidikan*, 12(3).
- Carroll, J. (2016). Making decisions on management of plagiarism cases where there is a deliberate attempt to cheat. *Handbook of academic integrity*, 199-219.
- Chan, C. M., Rahman, I. A., & Sanudin, R. (2020). Institutional Demands vs. Historical Baggage: What do Postgraduate Students Perceive of Plagiarism?. *International Journal of Academic Research in Progressive Education and Development*, 9(1), 39-52.
- Chrysler-Fox, P. D., & Thomas, A. (2017). Managing plagiarism of South African Honours students: Does an intervention have any effect?. *Koers: Bulletin for Christian Scholarship = Koers: Bulletin vir Christelike Wetenskap*, 82(1), 1-16.
- Chu, S. K. W., Hu, X., & Ng, J. (2020). Exploring secondary school students' self-perception and actual understanding of plagiarism. *Journal of Librarianship and Information Science*, 52(3), 806-817.
- Clough, P. (2000). Plagiarism in natural and programming languages: an overview of current tools and technologies.
- Colella-Sandercock, J. A., & Alahmadi, H. W. (2015). Plagiarism education: Strategies for instructors. *International Journal of Learning, Teaching and Educational Research*, 13(1), 76-84. Retrieved from <https://www.ijlter.org/index.php/ijlter/index>
- Curtis, G. J., & Vardanega, L. (2016). Is plagiarism changing over time? A 10-year time-lag study with three points of measurement. *Higher Education Research & Development*, 35(6), 1167-1179.
- Das, N. (2018). Intentional or unintentional, it is never alright to plagiarize: A note on how Indian universities are advised to handle plagiarism. *Perspectives in clinical research*, 9(1), 56.
- Dawson, M. M., & Overfield, J. A. (2006). Plagiarism: Do students know what it is?. *Bioscience Education*, 8(1), 1-15.
- Denzin, N. K., & Lincoln, Y. S. (2000). Paradigms and perspectives in transition. *Handbook of qualitative research*, 2, 157-162.

- Durrheim, K., & Wassenaar, D. (1999). Putting design into practice: Writing and evaluating research proposals. *Research in practice: Applied methods for the social sciences*, 54-71.
- Eaton, S.E., Guglielmin, M., & Otoo, B.K. (2017). Plagiarising: moving from punitive to proactive approaches. *Selected proceedings of the IDEAS Conference Leading Educational Change Calgary, Alberta*. <https://werklund.ucalgary.ca/ideas/>
- Fish, R. M., & Hura, G. M. (2013). Student's perceptions of plagiarism. *Journal of the Scholarship of Teaching and Learning*, 13(5), 33-45.
- Fishman, T. (2009). "We know it when we see it" is not good enough: toward a standard definition of plagiarism that transcends theft, fraud, and copyright.
- Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research*, 2(163-194), 105.
- Gullifer, J., & Tyson, G. A. (2010). Exploring university students' perceptions of plagiarism: A focus group study. *Studies in Higher Education*, 35(4), 463-481.
- Hansen, B., Stith, D., & Tisdell, L. S. (2011). Plagiarism: What's the big deal?. *Business Communication Quarterly*, 74(2), 188-191.
- Hendricks, M. and Quinn, L., 2000. Teaching referencing as an introduction to epistemological empowerment. *Teaching in Higher Education*, 5(4), pp.447-457.
- Howard, R. M. (2016). Plagiarism in higher education: An academic literacies issue?—Introduction. *Handbook of academic integrity*, 499-501.
- Ismail, K. H. (2018). Perceptions of plagiarism among medical and nursing students in Erbil, Iraq. *Sultan Qaboos University Medical Journal*, 18(2), e196.
- Joob, B., & Wiwanitkit, V. (2018). Plagiarism: Either intentional or unintentional, it is still plagiarism!. *Perspectives in clinical research*, 9(3), 151-151.
- Karasalides, T., & Emvalotis, A. (2019). Greek Undergraduate and Graduate Students' Opinions about Plagiarism Causes. *Επιστήμες Αγωγής*, 2019(1), 20-38.
- Khoza, S. B. (2015). Can Turnitin come to the rescue: From teachers' reflections?. *South African Journal of Education*, 35(4), 01-09.
- Khoza, S. B., & Mpungose, C. B. (2017). Can the self, them or/and it come to academics' rescue of Turnitin?. Paper presented at the "Beyond the Horizon" conference held at Manhattan Hotel Pretoria, South Africa, on the 24-26 April, 2017.
- Kuther, T. L. (2003). A profile of the ethical professor: Student views. *College teaching*, 51(4), 153-160.
- Lathrop, A., & Foss, K. (2000). Student cheating and plagiarism in the Internet era. *A Wake-up call*.
- Leonard, M., Schwieder, D., Buhler, A., Bennett, D.B. and Royster, M. (2015). Perceptions of plagiarism by STEM graduate students: A case study. *Science and engineering ethics*, 21(6), pp.1587-1608.
- Mack, L. (2010). The philosophical underpinnings of educational research.
- Magubane, P. (2018). *Students understanding of plagiarism: a case study of the Criminology and Forensic Studies Discipline (CFSD), University of KwaZulu-Natal (Howard College), Durban, South Africa* (Doctoral dissertation).
- Mahabeer, P., & Pirtheepal, T. (2019). Assessment, plagiarism and its effect on academic integrity:

- Experiences of academics at a university in South Africa. *South African Journal of Science*, 115(11-12), 1-8.
- McCabe, D. (2005). Cheating: Why students do it and how we can help them stop. *Guiding students from cheating and plagiarism to honesty and integrity: Strategies for change*, 237-246.
- Mishra, R., & Gautam, V. K. (2017). Issue and Challenges of Plagiarism in Digital Environment: A Conceptual Analysis. *Journal of Advancements in Library Sciences*, 4(3), 65-69.
- Mohamed, K., Abdul Samat, N. H., Abd Aziz, A. S., Mohd Noor, N. A., & Ismail, N. (2018). Academic plagiarism in Malaysia higher education institutions: legal perspective. *International Journal of Law, Government and Communication*, 3(13), 245-253.
- Molnar, K. K., & Kletke, M. G. (2012). Does the type of cheating influence undergraduate students' perceptions of cheating?. *Journal of Academic Ethics*, 10(3), 201-212.
- Moss, S. A., White, B., & Lee, J. (2018). A systematic review into the psychological causes and correlates of plagiarism. *Ethics & Behavior*, 28(4), 261-283.
- Mphahlele, A. and McKenna, S., 2019. The use of turnitin in the higher education sector: Decoding the myth. *Assessment & Evaluation in Higher Education*, 44(7), pp.1079-1089.
- Myers, M. D., & Avison, D. (Eds.). (2002). *Qualitative research in information systems: a reader*. Sage.
- Nelson, M. F., James, M. S., Miles, A., Morrell, D. L., & Sledge, S. (2017). Academic integrity of millennials: The impact of religion and spirituality. *Ethics & Behavior*, 27(5), 385-400.
- Nwosu, L. I., & Chukwuere, J. E. (2020). The attitude of students towards plagiarism in online learning: a narrative literature review. *Gender & Behaviour*, 18(1).
- Park, C. (2003). In other (people's) words: Plagiarism by university students--literature and lessons. *Assessment & evaluation in higher education*, 28(5), 471-488.
- Power, L. G. (2009). University students' perceptions of plagiarism. *The Journal of Higher Education*, 80(6), 643-662.
- Ramzan, M., Munir, M. A., Siddique, N., & Asif, M. (2012). Awareness about plagiarism amongst university students in Pakistan. *Higher education*, 64(1), 73-84.
- Selemani, A., Chawinga, W. D., & Dube, G. (2018). Why do postgraduate students commit plagiarism? An empirical study. *International Journal for Educational Integrity*, 14(1), 1-15.
- Smart, P., & Gaston, T. (2019). How prevalent are plagiarized submissions? Global survey of editors. *Learned Publishing*, 32(1), 47-56.
- Smith, M. R. (2017). *The incidence and correlates of intimate partner violence in a sample of South African university students* (Doctoral dissertation).
- Straw, D. (2002). The Plagiarism of Generation 'Why Not?'. *Community college week*, 14(24), pp.4-6.
- Thanh, N. C., & Thanh, T. T. (2015). The interconnection between interpretivist paradigm and qualitative methods in Education. *American Journal of Educational Science*, 1(2), 24-27.
- Thomas, A. (2017). Faculty reluctance to report student plagiarism: A case study. *African Journal of Business Ethics*, 11(1).
- Vardi, I., 2012. Developing students' referencing skills: a matter of plagiarism, punishment and morality or of learning to write critically?. *Higher Education Research & Development*, 31(6), pp.921-930.

- Wilkinson, J. (2009). Staff and student perceptions of plagiarism and cheating. *International Journal of Teaching and Learning in Higher Education*, 20(2), 98-105.
- Yeo, S. (2007). First-year university science and engineering students' understanding of plagiarism. *High Education Research & Development*, 26(2), 199-216.

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).\*

# **Action Research in the Methodological Process of the Triangular Approach and in the Stop Motion Technological Process**

**Vivian Cristina Belter Lunardi, Maria Aparecida Santana Camargo.**

Rio Grande do Sul

## **Abstract**

*with a qualitative approach, theoretical and empirical, the investigation sought to understand how the subjects read and interpret the different types of images that appear in their daily experiences. As a methodological path, action-research was chosen, as it is considered opportune for the research in question, in which various activities were promoted that exercised the perception and knowledge about the imagery representations analyzed. In order to achieve these goals, image reading was proposed as the theme, being delimited by the construction of citizenship based on image literacy.*

**Keywords:** art; culture; image; literacy; technology.

## **1. Initial considerations**

This reflection is part of the Post-Graduate Program in Sociocultural Practices and Social Development / Master's Degree, from the University of Cruz Alta (UNICRUZ / RS), being linked to the Research Line "Language, Communication and Society", whose focus is to discuss aspects interdisciplinary issues related to issues involving language and its multiple facets. With a qualitative approach, theoretical and empirical, the investigation sought to understand how the subjects read and interpret the different types of images that appear in their daily experiences. As a methodological path, action-research was chosen, as it is considered opportune for the research in question, in which various activities were promoted that exercised the perception and knowledge about the imagery representations analyzed.

In order to achieve these goals, reading of image was proposed as the theme, being delimited by the construction of citizenship based on imagetic literacy. The problem was thus circumscribed: How can Art Teaching contribute to an image literacy aiming at the citizen education of elementary school students? As a general objective, we sought to analyze, through action research, art as a social and educational practice that contributes to a group of 23 students in the 9th grade of elementary school, from an institution in the city of Ijuí / RS, take ownership of visual literacy with a more critical, participatory and open view to dialogue, encouraging different readings of the world and fostering citizen formation. At the same time, it was aimed through the specific objectives: a) To deepen knowledge about contemporary image reading; b) Investigate how adolescents appreciate, produce and interpret different types of images, using the stop motion technique; and, c) Identify, mediate and propose ways of image literacy to foster citizen education. To support the corpus of the research, scholars are brought in to guide the understanding of this subject, including: Barbier (2002) and Thiollent (2011) from the perspective of action research, Purves (2011) on the issue of Stop Motion and, in education, Freire (2003). Regarding art and visuality, Barbosa (1998; 2002;

2005; 2008) and Hernández (2000) stand out, for making a parallel between art and image, considering that these scholars give a vision of the multiplicity of possible paths to substantiate this activity.

The research corpus is anchored in these two methodological categories: the Triangular Approach and the Stop Motion Technology, which support this part of the investigation. Thus, the study has as a reference a sociocultural scenario dominated by images, in order to raise information that can assist in the understanding of image literacy as an educational action aimed at citizen education.

## **2. Action research**

Research as a field of knowledge search brings with it a methodological path relating the subject to his object through a complementary study formation, leading him to inquire about the meaning of some practices. Regardless of the type of research, we must keep in mind that we will continue to ask questions and seek solutions, as this cycle does not end, it is always remade, referring to a set of actions aimed at discovering new knowledge and, with them, to the construction of human knowledge.

According to Gil (2002, p. 17), “research can be defined as the rational and systematic procedure that aims to provide answers to the problems that are exposed [...] developing over a process that involves numerous phases, from the proper formulation of the problem to the satisfactory presentation results”.

In this perspective, it is assumed that the world is much more imagetic than written and that the image, being a dynamic resource, exerts a lot of influence on the way of thinking and acting. For this reason, it is believed that this study is relevant, since it allows adolescents the ability to develop reasoning and, consequently, a critical view in the face of the countless images and languages present in their daily lives. Studies on the theme suggest new attitudes that, in fact, are of interest in this research, which addresses Art Teaching. In turn, when it comes to methodology, there are approaches to teaching and learning art, showing a commitment to the social.

As a methodological path, action research was chosen, as it is a type of participatory, engaged research, as opposed to traditional research, which is more objective and independent. Thiollent (2011, p. 20) states that “action research is a type of social research with an empirical basis that is conceived and carried out in close association with an action [...] in a cooperative and participatory way”. As its name already states, action research seeks to combine research with action and practice, wishing to improve its understanding. It arose with the purpose of overcoming the gap between theory and practice, being eminently pedagogical, as it contributes to the development of attitudes and ways to explore human potential.

For Thiollent (2011, p. 21), “a research can be qualified as action research when there is really an action on the part of the people or groups involved in the problem under observation”, in which researchers play an active role with the purpose basic way of providing change in a practice or context, being the central subjects in the action-research process.

It is worth remembering the great contribution of one of the pioneers of this research approach, the German psychologist Kurt Lewin, who gained repercussions with the idea that the social scientist should leave his isolation, assuming the consequences of the results of his research and placing them in practice, to interfere with the course of events. Lewin (1978) in basing this method, conceptually highlights that action research deals with two types of problems, considered inseparable: the broad study of society and the analysis of



the specific situation. The peculiar character of the situation under study is determined by a scientific analysis of the facts, called diagnosis. The knowledge produced there guides the solution of the problem through an action planned and conducted by the group. Action research is based on a cycle of analysis, fact found, conception, planning, execution and more fact finding or evaluation. It is, then, a repetition of this entire circle of activities, really a spiral.

Likewise, Barbier (2002, p. 117) points out that the true spirit of action research is its "spiral approach". It means that "[...] every advance in action research implies the recursive effect due to a permanent reflection on the action". This permanent reflection is the essence of the pedagogical character of this research work, whose process of continuous reflection on the action makes it eminently collective, opening space to form research subjects. This modality encourages the teacher to reflect on his practice, in order to change the quality of his educational action and, consequently, the learning of his students.

According to Kemmis and McTaggart (1988), doing action research consists of planning, observing, acting and reflecting in a more conscious and rigorous way what is done in daily experience. In general, two ideas define a good research work: that it can be claimed that the methodology used is adequate to the situation and that it can be guaranteed in a certain way an addition to the knowledge that exists on the subject treated. According to Lewin (1978, p. 216), it is "a type of action research, a comparative research about the conditions and results of different forms of social action and research that leads to social action". The idea anchored in Lewin (1978) is composed of a cycle in four stages: data collection, diagnosis, implementation and evaluation. In the first phase, the field is explored, recording the relevant data on the problems presented by the client organization. These obstacles are not questioned in depth, the discussion is more on the way to enunciate them in a clear way, constituting them as the starting point to collect the data and make the diagnosis.

In this sense, it is essential to understand reading as a social practice and not just as an act of decoding. The images carry information, which makes it easier to get to know a society, since it constitutes another alternative for analysis and an imperative of contemporaneity, allowing the development of artistic practice and thinking with sensitivity and criticality. Thus, it is reaffirmed that action research can and should function as a research methodology, pedagogically structured, enabling both the production of new knowledge for the area of education, as well as forming research subjects, critical and reflective, extremely favorable in improving people's participation and bring about changes in social conditions.

Freire (2003, p. 20) already addressed the need to learn to do "the reading of the world preceding the reading of the word", not mechanically, but linking language and reality when referring to this widening of the gaze. In this context, it is clear that reading is not just decoding signs and codes, it is going much further. To read is to reflect, to think, to analyze, to dialogue with the other. It is by reading that one's own life story is resized and rethought. In the opinion of Pillar (2014, p. 14), "the first world we seek to understand is [...] where we live", that is, this which occurs in different spaces, with different subjects, in general. In addition, the aforementioned author (2014, p. 14) emphasizes that when we try to understand it, "we are doing readings of this world", a reading that, depending on the circumstances, can be "critical, pleasant, engaging, meaningful and challenging".

In the opinion of Gadotti (1991, p. 155), for Freire, "praxis is the union that must be established between what is done (practice) and what is thought about what is done (theory)". In turn, Zitkoski (2006, p. 11)

states that, "for Freire, education requires the dialectic unit theory-practice, which must be transformed into social praxis". Thus, the study investigated a project in the space in which the researcher teacher acts as a mediator in the discipline Art Teaching, with collaborative work, where an action research was carried out through collective deliberation, with students from the 9th grade of Elementary School in a school in Ijuí / RS. Classes took place once a week, in two periods of 50 minutes each, for three school months. The participants are teenagers of different age groups and the class consists of 23 students. The collected data were recorded through photos, videos and a field diary, in order to discuss, analyze and contextualize them in the light of the theories studied.

When it comes to children and adolescents, access to culture is guaranteed both in Articles 215 and 216 of the 1988 Federal Constitution, and in Article 58 of the Child and Adolescent Statute, Law no. 8.069 / 1990. According to Santos (2004), culture means a lot. It can be synonymous with refinement, sophistication and a person's elaborate education. But culture also includes the ways in which knowledge is expressed by a society, as is the case with its art, religion, sports and games, technology, science, politics. There are many ways to define and study culture, other cuts to make, other emphases to make. For Morin (2000, p. 52), "man is a fully biological being, but, if he did not have full culture, he would be a primate at the lowest level. Culture accumulates in itself what is preserved, transmitted, learned ... Man is only fully realized as a human being by culture and culture! ”.

From this perspective, the objective of the proposal was explained to the participants, the reasons that led to the choice of the theme, the importance of the research and how the group's participation would be. In addition, the concepts used to initiate this investigation were explained, emphasizing the meaning of image, visuality and its function as a builder of citizenship. According to Herbert (2010, p. 67), for Freire, citizenship:

“It is not something that comes from outside teaching, but something that is part of it. The fight in favor of the dignity of teaching practice is as much a part of it as it is part of the respect that the teacher must have to the identity of the student, to his person, to his right to be ”(FREIRE, 2001, p. 74). There is no distinction between teaching practice and citizenship. It is a teaching practice with citizenship in respect for the student, recreating meanings through the programmatic content under debate. The option for the content and the form of appropriation of knowledge needs to be in accordance with the reality experienced by students. Citizenship will be exercised from, and in reality, where reflective debate takes place.

The referred author (2010, p. 67) continues to affirm that:

Citizenship, in Freire, has characteristics of collectivity. As “no one frees anyone, no one frees himself: men free themselves in communion” (FREIRE, 1981, p. 27); likewise, citizenship is not restricted to the individual. Citizenship manifests itself through social relationships, through the exercise of producing collectivity and the power of continued relationships in favor of experiencing the rights and duties of individuals in social groups. A shared and participatory relationship is a necessary condition for the exercise of citizenship.

Based on this understanding, the next step was taken, where the School's Multimedia Space, the Art Room, the Computer Laboratory and other environments and instruments were used, which were fundamental so that the images could be projected, observed and analyzed. From these moments, Art History was used, with an emphasis on Contemporary Art, emphasizing Pop Art and mass culture and, later, some of the new artistic languages of today, with the works of the artist Vik Muniz, since this learning concerns the essential contents of this year and level of education, whose importance is central to this artistic issue and new means of expression, establishing dynamic interaction between art, technology and life.

The aesthetic-visual elements were appreciated, contemplated, analyzed and discussed, thus having a better understanding so that the participants could debate themes such as sustainability in their relationship with ethnic, generational, class and gender issues, including, for through audiovisual creations. That is, through the works that were analyzed, socio-cultural practices that could result in social development and, as a result, in the construction of citizenship itself were focused. Equally, the participants' impressions, perceptions, speeches and comments were examined.

Continuing, the subjects were invited to watch the Documentary entitled “Extraordinary Garbage” (MUNIZ, 2009), so that, next, they could develop some practical proposals in different supports in which they created characters with scrap and other materials, exploring the three-dimensionality. At that time, the research participants were instructed on how to create, move and edit the images step by step. From then on, with the use of information technologies, they made use of computational and photographic art that culminated in short films made using the Stop Motion technique (translated as a stopped motion).

These audiovisual creations can have many meanings and, therefore, can be approached in different ways. What was hoped for was a reflection on the audiovisual language, verifying what experiences could be used in this modality. The audiovisual language, as the word itself, is made of the combination of elements of two natures: the sonorous and the visual. It is noteworthy that this communication language is expressed with the combined use of different visual (signs, images, drawings, graphics, etc.) and sound components (voice, music, noise, onomatopoeic effects etc.), that is, everything that it can be seen and heard at the same time.

Stop Motion is, then, an animation technique widely used with the resources of a camera or a computer. The technological process of Stop Motion, combined with the Triangular Approach process, were the two methodological categories that underwent the study, which will be better explained in the sequence, still in this reflection.

This research was committed to the applicability of image reading to the researched public, allowing subjects the opportunity to interact. Likewise, it sought to open paths, providing new ways of reading and interpreting the world in view of a pedagogical practice through visual literacy, aiming at the citizen formation of adolescents in the Final Years of Elementary School. Before starting the investigation and drawing attention to the images, research, studies and planning were necessary for this process to actually happen. It was of fundamental importance to get as familiar as possible with the images presented, making the discussion and promoting activities that exercised their reading and decoding.

Right at the beginning of the school year, the classes were contacted, and the public surveyed would be the 9th year of elementary school, as it was a class that was about to complete a teaching stage and that already had a certain aesthetic knowledge and empirical. In this sense, the proposal sought to investigate and analyze how these adolescents were enjoying, producing and interpreting the diversity of images to which they were exposed, considering that, as already emphasized, citizen literacy is full, broad literacy, with a view not only to for reading words, but also for reading and decoding images, contributing to other perceptions of the world.

Firstly, it was essential to clarify to the students about the objectives of the proposal, mainly the reasons for choosing the theme “image reading” and the importance of the group's role. At that moment, some concepts about the word image were exposed, its role in history, how it influenced and influences societies, using a clear and accessible language, emphasizing the relevance of images in contemporary times, since these encompass multiple languages in the imagery context.

Among the contents proposed for the class over the year was the resumption of Art History as a potentializer of the imagery process, from prehistory to the present. A timeline was produced and Contemporary Art started to be emphasized. The artists and their relations with the environment and with the use of different materials and artistic languages were also highlighted. Still in this stage, the students were invited to

research, in pairs, the life and work of a contemporary artist so that, later, they could socialize with the other colleagues the different ways of representing and illustrating their research, in order to understand how they would represent your ideas in the chosen productions.

Then, they watched the documentary entitled “Who's afraid of contemporary art?”, Produced by Cocchiarale. This author (2006, p. 67) points out that “contemporary art can be in several places simultaneously, performing different functions, but the main thing about it is the new types of relationship that it makes us establish”. In this way, several artistic and conceptual approaches were presented and discussed, so that the subjects already had an idea of where it was intended to go, realizing that art is not restricted to museums, biennials and galleries, but can be everywhere, as well as inserting the image. In this context, Camargo (2005, s.p.) mentions that “images have always existed, but due to technological advances in no other time did humanity live so immersed in an avalanche of [...], information and texts [...] We are surrounded by certain images, of all types, [...] who have a very strong power, who say a lot and who speak for themselves”.

By being in contact with the image, the student ends up reflecting on his role and his insertion in the lived space. So that the next step was to develop the activities on photocopied sheet with support material explaining what an image is and the different possibilities of interpreting an image, analyzing them. Thus, they selected an “X image” and sought to examine, based on a proposed script, establishing their specific codes, that is, an integrated system of signs, passwords, symbols and messages.

With regard to the codes of art that surround the subjects, it can be pointed out that the individual who does not have access to them, finds it more difficult to read an image, for example, requiring greater effort to find his place in the world. From Camargo's point of view (2005, s.p.), “when trying to decode these signs, the student makes a reflection on the world in which he lives and acts on it, seeking to transform it. Understand the world in order to transform it and place yourself in it: this is one of the principles of building citizenship itself”. Thus, when the next meetings took place, questions about art were questioned, what were the new artistic languages that were presented and what has been drawing attention. The final result was made through drawings, on A3 bond paper, with a free choice technique.

### **3. The Triangular Approach in Developed Educational Action**

The triangular approach is, therefore, a reference, a concrete possibility of complex work in art / education; it is up to the art / educator to take into account the various possibilities of expression addressed by the scope of artistic objects and the educational specificities of training that are relevant (PIMENTEL, 2010, p. 212).

The Triangular Approach was systematized by Ana Mae Barbosa, in the 1980s, having taken on several dimensions, among them that of expanding the field of art / educating task in which it seeks to broaden to become acquainted with other fields of knowledge becoming art / experiences educational, liable to build teaching / learning methodologies in art, meaningful and consistent, giving rise to the expansion of limits and boundaries, both those of a cultural and interdisciplinary nature for the study of art, considering this a privileged moment to exercise artistic thought.

This approach to Teaching Art, according to Pimentel (2010), was known in Brazil initially as “Triangular Methodology”, a designation that was accepted by Barbosa herself in her book “A Imagem no Ensino da Arte” (1991). When realizing, however, that it would not be, nor would it have the rigor of a methodology, the author carried out, in the work “Topics Utopians” (1998), theoretical revisions starting to call it

"Triangular Proposal", considering then an approach that could be followed. Subsequently it became a "Triangular Approach", because in addition to understanding what methodology is the art / educator, he also realized that the proposal is a word worn by the thousand and one that is poured by the powers over the heads of the art / educators. By understanding that, in art and in education, semantic problems are never just semantic, as it involves conceptualization, Barbosa took the liberty to replace, whenever possible, the terms "Methodology" and "Proposal" with "Triangular Approach" in his last books.

The Triangular Approach referred to the improvement of Art Teaching, enabling different paths, based on an integrative pedagogical work, in which artistic making, analysis or reading of images (including the field of art meaning) and contextualization interact with the critical, reflective and dialogical development of the student in a socio-cultural contextual dynamic. It is important to emphasize and also be clear that the main actions of the triangular approach - to enjoy, contextualize and do (not necessarily in this order) are dynamically closely linked together. In his interface with the triangular approach, Pimentel (2017, p. 307) presents a close relationship between the three basic actions of this interface, making it happen - contextualizing:

Doing aims to provide a network for the construction of knowledge based on direct contact with aesthetic experiments, fruition aims to provide other perceptions of the object, that is, fruition presupposes knowledge and the consequent correlation of contextual elements, contextualizing aims to establish relationships through historical understanding, social and cultural aspects of Art in societies.

The PCNs - Arte (1998) were based on Barbosa's assumptions, emphasizing that the teaching and learning of artistic content are based on three pillars: appreciating, making and reflecting. However, it is clear that, on many occasions, the study of art is only limited to doing. Art History is often seen in isolation from other events at the time of the creation of the artistic object, making it difficult to understand the discipline. In the present investigation, the three fundamental conceptual assumptions for the Triangular Approach were adopted. The proposal systematizes by Barbosa (2002, p. 70), composed of the interconnected teaching between History of Art, reading of the work of art and artistic making, at the same time, it is one of the main references of Art Teaching in Brazil, because, as it highlights Rizzi (2002, p. 70):

[...] allows a dynamic and multidimensional interaction, between the parts and the whole and vice versa, in the context of Art Teaching, that is, between the basic disciplines of the area, between the other disciplines, in the interrelationship of the three basic actions: reading, doing and contextualizing and in the interrelationship of the other three resulting actions: decoding / coding, experimenting, informing and reflecting.

This approach seeks to encompass several teaching-learning points at the same time, focusing teaching on three axes. That is to say, it maintains the artistic practice (experimentation and expression) and adds the reading of the work of art, combining these two disciplines, criticism and aesthetics, as well as contextualizing and promoting the intersection of experimentation with decoding and information artistic object.

Among the pleasures and troubles generated by the dissemination of this proposal at the end of the 1980s, what really matters is that, since then, Art Education in Brazil has changed and, at the same time, there are more researchers and teachers defending the importance of this idea (RAMALHO and OLIVEIRA, 1998). In Barbosa's view (2005), the construction of knowledge in Art happens when there is an interconnection between experimentation, coding and information.



Barbosa (2005) proposes that the Art Teaching program be developed based on three basic actions: - Reading Works of Art: it is based on the discovery of the students' critical capacity. Here, Art is not reduced to right or wrong, it considers pertinence, clarification and comprehensiveness. The object of interpretation is the work and not the artist; - Making Art: it is based on stimulating artistic making, working, among other actions, on rereading, not as a copy, but as interpretation, transformation and creation; and, - Contextualize: it consists of interrelating Art History with other areas of knowledge. According to this author (2005, p. 142), the contextualization of the work of art is not only historical, "[...] but also social, biological, psychological, ecological, anthropological [...]" because contextualizing is not just telling the history of the life of the artist who made the work, but also to establish relations of this or these works with the world around, is to think about the work of art in a broader way".

It is based on the principle that learning in art is not only what the subject knows about others and things, but an essential factor for knowing about himself, making it available for other people to experience the same process and thus contribute socially as information or even a challenge for other people. In this sense, the more each individual knows about himself and how he can contribute to society, the more it will benefit. The assumptions of the Triangular Approach in the Art Teaching process start to create links between these and the new contemporary technologies, so present in the life of the research participants. The experience in the students' lives includes experiences so that they can present themselves as important participants in social life and aware of their potential, given that art is still a social construction.

In this way, Art Teaching will make sense to the student if he knows and recognizes the importance he will have in his daily life, being urgent the need for a change in educational paradigms. This is so that people are literate not only with the mastery of verbal and written language, but also aesthetically, providing the chance to become less passive and more critical viewers in the face of the images that surround them.

In this regard, Fusari and Ferraz (2001, p. 80) emphasize that "knowing the images that surround us also means expanding the possibilities of contact with reality, it means seeing more and perceiving more". Thus, it becomes one of the strongest, most disturbing and eloquent ways of expressing and originality of a given culture at a given historical moment, providing the indispensability of more recent studies.

Interpreting images is fundamental for any type of current activity in which it expands the expressive, aesthetic, cognitive and perceptual world, extending the abilities to see, judge and interpret the historical, economic, social, political and cultural context. Contemporary society, with its scientific-technological research, brings countless opportunities in the field of images. It coexists with other visual and audiovisual languages that have their own specificities, but that integrate the universe of communication and the arts, being significant in the formation of the globalized subject.

#### **4. Art and Technology: Stop Motion**

One of the first forms of communication for man was through paintings and drawings made in the caves, extending to the present day. So, for thousands of years man has been telling his story through images and what has changed over the centuries has been the technology used for its execution.

To propose an Art Teaching with the use of computers in contemporary society is to create new forms of expression, expanding readings and artistic productions. In recent centuries, technologies have entered all



spheres of human life. Education has become one of the targets of this process of inserting these media in the dynamics of everyday life. The impact of technological means on artistic creation has been producing new forms of expression throughout the History of Art and the greatest challenge of education through art is found in the fact that it is no longer just another subject in the school curriculum and become “something incorporated into the subject's life, that makes him search for the presence of art as a necessity and a pleasure, as fruition or as production, because in both art it promotes the creative experience of awareness” (MEIRA, 2003, p. 131).

In this context, Information and Communication Technologies emerge, that is, ICT. As a result, it is clear that teachers need to be up-to-date in order to develop an articulation between art and technology in the classroom, which makes it possible to disseminate the knowledge of this event linked to a critical awareness of the values of citizenship. In this way, the educator will find in technology a favorable support for art classes, as well as the research of images and artists that explore social themes. Art at school is not just the performance of simple activities, but is an area of knowledge, a discipline with specific contents, which expands its meaning and meaning, and can contribute to the development of subjects and, mainly, to citizen education.

Adapting to new artistic languages and making use of contemporary culture, which explores many expressions and means of communication, associating images with sounds, given that many artists replaced the paint palette with a camera and, through it, sought to capture a poetic look at the world, the idea arose to explore the documentary “Lixo Extraordinário” using Stop Motion technology. Stop Motion was a proposal made by the researcher teacher to the subjects involved, which was enthusiastically accepted.

In the view of Purves (2011, p. 6), stop motion can be defined as “the technique of creating the illusion of movement or performance through recording, frame by frame, manipulation of a solid object, doll or clipping image in a physical spatial scenario”. According to Rodrigues (2015, p. 145), “it is an animation technique that, through the manipulation of an object, creates the illusion that it is moving by itself. The object is articulated in small movements and photographed”. For this, you can use a camcorder, camera or mount on a computer.

Complements Ciriaco (2009) that, scientifically speaking, Stop Motion is only understood as movement by the phenomenon of Retinal Persistence. It causes the illusion in the human brain that something moves continuously when there are more than 12 frames per second. In fact, the movement of this cinematographic technique is nothing more than an optical illusion. This is an animation technique widely used today, in which real models with different materials are used, such as, for example, modeling clay. Models are moved and photographed frame by frame and, later, mounted on a cinematographic film, creating the impression of movement. Sound effects such as voices, noise, music can be added. One of the most well-known films made with the technique was Henry Selick's “Strange World” (1993) and screenplay by Tim Burton.

Other techniques follow the same process, but with a succession of drawings or with images generated by the computer in 3D. The movement is created when the camera is immobilized and there is no real movement, which considers this to be an action of pure illusion. The image pauses for a fraction of a second in front of the projection beam until it is replaced by a subsequent image (PURVES, 2011, p. 7). The animation of Stop Motion is slow and quite laborious, since a very short film requires an enormous amount of resources, in addition to patience and persistence. The fact that there are characters ends up being one

of the greatest satisfactions, in addition to the fascination of seeing them in movement and reflecting on the best way to use the technique with the different subjects. For the short film to become a video, some steps are indicated, namely: a) Premise - It would be the first spark in history; b) Storyline - The story in a paragraph; c) Argument - Telling the story in detail; d) Script of history - Written history with the camera in mind; e) Filming Script - Organizes the scenes, places, frames; and, f) Storyboard - These are quick drawings, narrating the main scenes of the script.

In addition to keeping in mind that a good story is told with sounds and images, many cinema directors have also used this animation in the past decades, combining the relatively modern world with the ancient tradition of puppetry, that is, the act of moving puppets / dolls . What makes it different is the fact that it is not made or filmed in real time, nor executed in front of the audience, but programmers are not seen, making use of other more innovative techniques with successful creations. “What people like about the Stop Motion animation is that it is real. It is a magic trick, taking real things, real scenarios and making them come alive with movement” (PURVES, 2011, p. 44).

Rodrigues (2015, p. 145-146) states that, at least, four phases take place to constitute the Stop Motion film: Phase 01: Character - Constructed with some type of material (clay, sustainable materials, ready-made objects. ..); Phase 02: Scenario - A scenario is built that will be preferably static; Phase 03: Image capture - Using a digital or cellular camera, one position is recorded at a time, the character is moved (one leg at a time, for example); Phase 04: Editing - Using video editing software, the various photos are placed in sequence. This is the sequence that will constitute the film.

Everyday this animation is appreciated for its own unique merits, no longer needing to compete with the sophistication of computers. Many programs can be used, such as: explorer, movie maker, filmmaker, Vegas and many others. The genres used can be countless, including animation itself, fiction and even documentaries. The audience that contemplates it, undoubtedly, likes to see, appreciate and understand the trick, being that it is still an art form and, as such, many films prefer to focus on a visual idea or technique and not on one. narrative itself. It is essential that there is a harmony between aesthetics and technology.

In this process, it is possible to explore all materials and elements, such as texture, lighting, color, depth, detail and character, among others. Each aspect ends up working in harmony with the others. The aim of all this is to ensure that everyone involved has a clear and shared understanding of the main elements required for the production and completion of the film. As it is necessary to create absolutely everything, it is important to make the most of each element, allowing them to contribute to its realization. “Animation is more than mobile characters, it is about narrative, and each element can help to tell this story” (PURVES, 2011, p. 134).

In this way, digital technology has brought countless possibilities and with the use of technological resources, it is observed that the image has replaced, numerous times, the word and writing as a means of communication, thus emphasizing what has been called culture visual. However, Hernández (2000, p. 54) highlights that the “primary importance of visual culture is to mediate the process of how we look, and to contribute to the production of worlds, that is, so that human beings know much more than they have personally experienced ”. Upon completion of the short film through Stop Motion, an exhibition of these works was held so that the other classes of the school, other students and the school community could appreciate and contextualize, as well as disseminate on social networks. The final result was socialized in

public spaces of the institution, through the exhibition of the short films produced.

The complexity of photographic records and film montages makes interpretation essential, active reading incorporating different technologies and discourses, performing a cultural function through their narratives, for those who make / produce and for the audience / appreciators, who go beyond the pleasure of composing history and entertainment. In addition, the subjects' perception of everyday social issues gains new perspectives, with a different look, broadening horizons.

These reflections are valid for photography and other languages, whether visual or audiovisual, being intermediated by its actors, technological means and spectators, since cinema, as art of moving images, maintains close ties with photography. As already mentioned, even a very short film requires an enormous amount of resources, patience and inexhaustible energy to handle the visual tricks, for example, the illusion of movement, the details of the plan, framing, scenery, lighting, special effects. Its most visible and uplifting use is in fully animated films, when each accessory, costume, character is created on a miniature scale.

With all the pre-production completed, you are ready to animate. Most films will have the dialogue recorded and many are superimposed on the images extracted from the picture frame by frame, or when filmed it has already been heard several times before starting, to make the sequence more feasible. According to Purves (2011, p. 187), "Stop Motion requires a particular way of looking at things - not everyone is able to look at an inanimate object and see a character or a dramatic situation. Not everyone can see a simple object and ask what if? ". The recommendations are equally private, but it is something you should love to do or, otherwise, what could be very special will seem full of sound and fury, which means nothing.

In this sense, the school, as a space for reflective educational practices, can relate art to everyday life, contributing to this awareness, aiming at expanding the capacity for understanding and criticizing the reading of the world in which we live. It is worth mentioning that there could be discomfort and a minimal risk for the participants when the activity was given, since they could be led to reflect on their social praxis regarding the theme of sustainability in their relationship with ethnic, class, gender and generational. However, from the moment when there was more knowledge on the subject, it was possible to reconstruct thoughts, actions and reader and discursive praxis, which, consequently, meant that there was no room for discomfort or risk.

## **5. Final considerations**

It is noticed that society has been undergoing major changes in its social, cultural, economic and political structure, establishing new standards. Citizen education stands out as necessary and beneficial, since one of the reasons why image reading does not occur, is, perhaps, due to the lack of knowledge in art, or to the impossibility of visual literacy, being that this was a of the factors that aroused the interest for the investigation. Barbosa (2008, p. 18) states that the need for visual literacy has confirmed the importance of the role of art in school. The reading of the visual discourse, which is not limited to the analysis of shape, color, line, volume, balance, movement, rhythm, but mainly is centered on the meaning that these attributes, in different contexts, give to the image is an imperative of contemporaneity .

According to the author (2008), visual literacy is of great significance, as it expands knowledge of the world and cultural development, thus understanding itself as an education favorable to social integration.

Citizen education is, therefore, one of the aspects that contribute to inclusion and active participation in the social space. From the point of view of education, it means the formation of an autonomous subject, who knows how to preserve distance and the ability to judge from criteria referenced in its human sense. Education for citizenship is to encourage openness to the ethical sense of existence in society, legitimizing its social function and contributing to the conscious development of its citizen formation. Mitchell (2017, p. 29) warns of the following: "What do you want images? It has some kind of meaning, it must be because we assume that the images are like forms of life, driven by the desire and the appetites ... Why should there be a question that is apparently useless, frivolous, does it mean that we need our attention for a moment?". In view of these findings, Art Teaching is of fundamental importance, since it greatly contributes to building the bases for human beings to develop the potential that will accompany them throughout their lives. As Barbosa (1998, p. 31) argues, "[...] more than 25% of the professions in this country are directly or indirectly linked to the arts, and their best performance depends on the individual's knowledge of art". The author (1998, p. 20-21) points out that "it is proven that 82% of our informal knowledge comes through images".

It is, therefore, a dialectical relationship, historically dynamic and constituting, by definition, the individual and society in the process of citizen formation. It is essential that the subject is prepared for this autonomy of thought and choice, since he is bombarded by information that must be filtered, analyzed and criticized, so as not to become a repeater manipulated by the mass media.

Thus, the pedagogical intervention helps to transform this attitude into conscious action, so that, afterwards, it can elaborate its own processes. It is a vision that, if properly developed, can lead to a more effective use by each citizen, since when someone approaches the experiences of other people, or from other points of view, the experiences themselves acquire a greater perspective and the understanding of the social context ends up being enriched. The role of interpretation is the central part of a curriculum based on understanding the world.

## 7. References

- A. C. Gil. How to design research projects. 4. ed. São Paulo: Atlas, 2002.
- A. D. Pillar (Org.). The Education of the View of Teaching Arts. 8. ed. Porto Alegre: Mediação, 2014.
- A. M. Barbosa. Utopian Topics. Belo Horizonte: Com Arte, 1998.
- A. M. Barbosa. Concerns and changes in art education. São Paulo: Cortez: 2002.
- A. M. Barbosa. The image in art education. São Paulo: Perspectiva, 2008.
- A. A. Barbosa. Rereading, quotation, appropriation or what? In: BARBOSA, A M. Barbosa (Org.). Contemporary Art / Education: international consonances. São Paulo: Cortez, 2005. pp. 143-149.
- B. Purves. *Stop-Motion*. Porto Alegre: Boockman, 2011.
- Brasil. National Curriculum Parameters - Art. 3. ed. Brasília/DF: Ministry of Education / Secretariat of Fundamental Education, 1998.
- D. Ciriano. O que é *Stop Motion*? 15 Jun. 2009. Available in: <<http://www.tecmundo.com.br/2247-o-que-e-stop-motion-.htm#ixzz1IgD0xwmX>>. Access in: 2 dez. 2020.
- E. Morin. Science with Conscience. 4. ed. Rio de Janeiro: Bertrand Brasil, 2000.

- F. C. Rodrigues. Art: context and production - Elementary School: 6th to 9th grade. 1. ed. São Paulo: Leya, 2015.
- F. Cocchiarale. Who's Afraid of Contemporary Art? Fundação Joaquim Nabuco, Recife: Massangana, 2006.
- Movie Jack's Strange World. Direction: Henry Selick. Production: Tim Burton and Denise Di Novi. 1 DVD (76 min), color, fantasy / musical film. Walt Disney Pictures, 1993.
- F. Hernández. Visual Culture, Educational Change and Work Projects. Porto Alegre: Artmed, 2000.
- J. J. Zitkoski. Paulo Freire and Education. Belo Horizonte: Autêntica, 2006.
- J. L. Santos. What is Culture? São Paulo: Brasiliense, 2004.
- K. Lewin. Group Dynamics Problems. São Paulo: Cultrix, 1978.
- L. G. Pimentel. Triangular approach and self-narratives: autobiography and learning in Art. Magazine GEARTE, Porto Alegre, v. 4, n. 2, pp. 307-316, may/aug. 2017.
- L. G. Pimentel. Enjoy, contextualize and experiment as a possible basic strategy for research and the possibility of diversity in Art Teaching: the twenty-year-old contemporary. In: A. M. Barbosa, and F. P. Cunha (Orgs.). Triangular Approach in the Teaching of Visual Arts and Cultures. 1. ed. São Paulo: Cortez, 2010, pp. 211-228.
- M. A. S. Camargo. Imagetive Literacy: a way of building citizenship itself. 2005. Available in: <<http://livrozilla.com/doc/1046636/maria-aparecida-santana-camargo>>. Access in: 17 set. 2016.
- M. C. S. Rizzi. Methodological Paths - Chapter 5. In: A. M. Barbosa (Org.). Concerns and changes in art education. São Paulo: Cortez: 2002. pp. 63-70.
- M. F. Fusari, and M. F. Ferraz. Art Teaching Methodology. São Paulo: Cortez, 2001.
- M. Gadotti. Invitation to Reading by Paulo Freire. 2. ed. São Paulo: Scipione, 1991. (Series Thinking and Action in Teaching).
- M. Meira. Creation Philosophy. Porto Alegre: Mediação, 2003.
- M. Thiollent. Action Research Methodology. 18. ed. São Paulo: Cortez, 2011.
- P. Freire. The Importance of the Act of Reading: in three articles that are completed. 22. ed. São Paulo: Cortez, 2003.
- R. Barbier. Action Research. Brasília: Plano, 2002.
- S. Kemmis, and R. McTaggart. *The Action Research Planner*. 3. ed. Victoria: Deakin University, 1988.
- S. P. Herbert. Citizenship. In: D. R. Streck, E. Redin, and J. J. Zitkoski (Orgs.). Paulo Freire Dictionary. 2. ed. Belo Horizonte: Autêntica, 2010. pp. 67-68.
- S. R. Ramalho e Oliveira. Reading Images for Education. Thesis (Doctorate in Communication and Semiotics) – Pontifical Catholic University of São Paulo, São Paulo, 1998.
- V. Muniz. Extraordinary Garbage. Direction: Lucy Walker. Co-direction: João Jardim and Karen Harley. 1 DVD (99 min), NTSC, color, documentary. [S.I.]: Paris Movies, 2009.
- W. J. T. Mitchell What Do Images Want?: A Critique of Visual Culture. 1. ed. Autonomous City of Buenos Aires: Sans Soleil Ediciones Argentina, 2017.

### Copyright Disclaimer

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

## **Discourse Analysis On Physical Activity For People With Disabilities**

**Cristiane Martins Viegas de Oliveira**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Leandro Rachel Arguello**

Local Development Doctorate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Diego Bezerra de Souza**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Antonio Carlos Dorsa**

Local Development Doctorate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Raphael Ricardo de Jesus Portela**

Local Development Doctorate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Aline Ortega Soloaga**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Raquel Borges de Barros Primo**

PhD in the Health Sciences Graduate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**Geanlucas Mendes Monteiro**

Health and Development in West Central Region Graduate Program, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Flávio Henrique Souza de Araújo**

Health Sciences Doctorate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.



**Dayane Caetano**

Sciences and Movement Mastering Program, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Tayla Borges Lino**

Sciences and Movement Mastering Program, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Juliana Vicente de Souza**

Sciences and Movement Mastering Program, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Abstract**

*The subject discussed refers to the importance of physical activity for people with disabilities, both in physical and psychological aspects. The general objective of this work is to identify the relationship of the person with disability to the sport, as guaranteed by the Federal Constitution, giving the person with disability the right to the sport. As a specific objective, to analyze through journalistic texts what is the perception of the person with disability in face of his/her limitations. The methodology used will be an analytical approach, together with bibliographic and documentary research. The relevance for the study of this theme is the look at the person with disability, which is often forgotten by the public power, or prejudged by the society that most of the times does not know the concept of disability, or when they come across it, they do not know how to act or how to treat a person with disability. Maybe because they don't even know how they think according to their current life condition, as to the difficulties, as to the accessibility, as to the expectations, as to the way they are seen or treated by society. This raises a question: How are people with disabilities treated by society and public authorities? Are their rights being respected? This answer can be traced back to a critical analysis of a person with disability's discourse.*

**Keywords:** People with Disabilities; Physical Activity; Critical Discourse Analysis.

**1. Introduction**

This study is about the critical analysis of texts that refers to the person with disability in front of the paradesporto, as assured by the Constitutional Charter of 1988 and the Brazilian Law of Inclusion for People with Disabilities (Law no. 13.146/2015). People will be interviewed, being the first one a post-graduation teacher in Physical Education; as second person interviewed, the Olympic Gymnastic technique Georgette Vidor; and finally, the former Olympic Gymnastic athlete Laís Souza. Relevant interviews regarding the area of the person with disability, the coach and the athlete. The critical and vehement analysis from the technical point of view and from the real point of view.

In chapter number 2 will be presented a brief historical context on the contribution and history of sport in the lives of people with disabilities. In chapter 3 will be presented a brief concept on the analysis of the

speech according to authors Van Dick and Fairclough. In chapter 4 the categories of discourse analysis will be discussed, divided into macro structures of discourse analysis. And finally, the texts that were analyzed.

## **2. Historical context of the sport for people with disabilities**

The practice of physical activity that concerns is important the practice of activities that consider the capacity, needs and limitations, contributing to their development and improvement of the movements essential for the realization of the activities performed in daily life (apud Azevedo, Barros, 2003). The person with disability when practicing sports, society identifies him/her as an athlete and shows pride in it. The history of sports for people with disabilities began in England, when the paralympic sport was initially created for the rehabilitation of soldiers severely wounded in war. The National Center for Spinal Injuries at Stoke Mandeville Hospital, which sheltered wounded people from World War II, emerged. In the face of this, two chains were created. The first current, with a medical focus, was exhibited by Gutmann, who used the sport as an aid in the rehabilitation of patients seeking to alleviate psychological problems. The second current, in North America, presents the sport as a form of social inclusion, which causes the competitive sense of the sport (ARAÚJO, 1997 apud BARROZO, 2018). In this sense, the large number of military personnel who suffered significant physical injuries in World War II took a large part of the European countries that participated in the conflict, which triggered the beginning of medical rehabilitation work for war veterans. These are the origins of paralympic sports, which through the application of sport activity, there is the possibility of restoring the physical and mental health of the individual, is what describes Nascimento et al (2012) apud LIMA (2017).

In 1948, at the London Olympic Games, 16 military men and women who obtained some kind of injury took part in the archery competition along with the other entries. In 1952, some Dutchmen enrolled in the games offered by the hospital, putting the competition on an international focus, which were the first steps to organize the first Paralympic Games later in 1960 (TORRI, 2017).

The sport for people with disabilities began in 1960 in the city of Rome, and the first Olympics was called "The Olympics for the Disabled" (COSTA and SOUZA, 2004, apud BARROZO, 2018). According to the authors, in 1964 at the Tokyo games, the term Paralympic was derived from the junctions of the words paraplegia and olympic.

However, it is currently recommended that national committees use the term paralympic as a way of adjusting terms because the International Committee is called the International Paralympic Committee (BARROZO, 2018).

In Brazil, only after 1950, physical education arouses the attention of physical activities for people with disabilities (apud Costa, Sousa, 2004).

As for the evidence, the sport for people with disabilities in Brazil happened, above all, due to the good performance of the Brazilian delegation in Paralympic Games and also in other world competitions. Thus, in the national scenario, the current formation of the adapted and paralympic sport is linked to a greater organization of the Institutions and to the financial support obtained by companies, through programs linked to the federal government. In 1995, the Brazilian Paralympic Committee (CPB) was created. Before that, the sport for people with disabilities in Brazil was only amateur. Thus, Paralympic sport was developed,

in a slow and slow process (BEGOSSI and MAZO, 2016).

In order to insert people with disabilities into the sports world, Paralympic sport has been growing in large proportions. This inclusion consists of the insertion of bodies that are out of regularity, whether physical or physiological, determined to reaffirm themselves through sports. People with disabilities have been provoked to practice sports activities, giving originality and notoriety to the sports they practice through messages that involve inclusion and overcoming, also included in common sports (GONÇALVES; ALBINO; VAZ, 2009, apud TORRI, 2017).

### **3. Spinal cord injury**

When it comes to physical disability, spinal cord injury is significant, which is described as motor transformations of negative sensitivity and neurovegetative disorders below injury (MELO 2009, apud SCHOELLER, 2012). It also describes the author, the concept of tetraplegia and paraplegia:

Some studies point to spinal cord injuries related mainly to violence, resulting from accidents, firearm injuries - FAF, shallow water diving - MAR, and falls (ALA, 2009). It is classified as tetraplegia, when it affects all four limbs, or paraplegia, when it only affects the lower limbs. It can still be complete or incomplete: complete results in loss of motor and sensory functions below the injury and is called American Spinal Injury Association (ASIA). When incomplete, it varies from ASIA (B) to (D), with D being the one with the lowest sensory-motor sequel (SCHOELLER, 2012, p.96).

Research shows that Brazil has the 2nd largest cause of spinal cord injury in the world, and that it is estimated that each year 50 new cases arise for every one million inhabitants, which in 2010 alone, were 96,000 new spinal cord injuries (Fawcett et al, 2011 apud SCHOELLER, 2012).

Cragg et al (2012), asserts that physical training has brought improvements in quality of life and avoided functional weakness in people with physical disabilities who use wheelchairs. In this sense, Medeiros (2018) suggests that the maintenance of health and the well being of physical activity are generated by the practice of regular physical activity.

The spinal cord injury not only causes physical injuries but can also bring psychological injuries, such as the person who normally performed his or her duties on a day-to-day basis, begins to encounter some difficulties such as going to the bathroom alone and even eating what can trigger a depressive state (LIMA, 2017). However, people with disabilities have been progressively inserting themselves in paradesportive proposals with the stamp of moving away from sedentariness, for better quality of life, social interaction, self-esteem among others (BRAZUNA and CASTRO, 2001; MARQUES et al., 2009, apud LIMA, 2017). Nowadays, there is an increase in the practice of sports for people with disabilities. Together with this, there is a need for monitoring programs and training capable of ensuring the necessary adjustments that allow the acquisition of excellent levels of income that favor individual and regular team performance (GODOY et al, 2017).

### **4. Conceptualizing discourse analysis**

Van Dijk (2013) briefly addresses notes and concepts of what is to be a discourse analysis. He points out aspects that must necessarily be present for a good targeting and analysis of a discourse. He starts the author

on what is not discourse analysis, reporting not a method or line of research, but a critical point of view on knowledge. He adds that all discourse analysis must be rigorous where it must stand out as essential characteristics, due to the deep discursive relationships, with the dimension and objective of being reachable to all.

The author discusses the relevance of cognition, or rather, of knowledge and learning within critical discourse analysis, in the sense of interaction and communication. And also, from the social aspect, with a solid and broad linguistic base. It clarifies that cognition means analysis, the social aspect, and society means inclusion. It emphasizes that the most relevant structures of the text must be analyzed.

Fairclough apud Silva (2017) asserts that the discourse is formed by social identities, their relationships and the techniques in which they find themselves within knowledge and opinions. The social difficulties are inserted in the text, and are developed from the text itself, which is the core of the analyst. It emphasizes that discourse establishes meanings for how to react, a way of being and a way of representing. The author presents the three-dimensional aspect of discourse, the first being the text, which refers to the study of the linguistics of the text; after the discursive practice, which refers to the textual interpretation, adding that the discourse is the analysis of the representation of reality in search of indicators that point to the enunciator's way of being; and finally, the social practice as a factor directly linked to the ideology present in the sense of words, in the organization of the text, present in the harmony of discourse.

It clarifies (2018) that discourse analysis does not apply only to textual writings, such as documents, letters and interviews, but to any model that can generate meaning, as exemplified by visual texts expressed through television, cinemas, also referring the author to physical texts.

Foucault (1979) apud Nogueira (2018) presents as effect the power that brings speech. He still uses the term speech to propose different ways of building areas of knowledge. His idea comes to be of paramount importance in the critical analysis of discourse. Burr (2013) apud Nogueira (2018) asserts that the center of research is no longer the individual and his purposes turning to language and the productive potential it can bring. According to the author, critical discourse analysis, with a Foucaultian look, facilitates and limits what can be said, by whom and where it is said.

Fairclough understands discourse as a social practice that reproduces and transforms social realities. It also represents the analysis of discourse in three guiding principles. The first, discourse as a natural and meaningful practice of the world; discursive practice with several classes of discourse; orders of discourse, in the integrality of discursive practices.

## **5. Texts**

**TEXT 01** - Interview granted on October 08, 2017, with the athlete Laís Souza, former Brazilian Olympic gymnast. Available at: <https://www.bbc.com/portuguese/geral-41262174>>

"Spending \$20 thousand, 'controlled' pee and help from stars: as Laís Souza maintains the hope of walking again".

One day she was doing maneuvers in the air and landing in the snow; the next, she was lying on a stretcher without even being able to breathe alone. Laís Souza's life changed completely on January 27, 2014, when

she suffered an accident in the United States during an air skiing training for the Sochi Winter Olympics in Russia. More than three years later, the former gymnast arrives for the "training" with the same smile on her face, although she no longer has the podium in sight. In Ribeirão Preto, in the countryside of São Paulo, she puts a funk to touch her cell phone and starts an intense routine in physical therapy. While her hands sketch a minimal wave movement in the rowing exercise, her eyes close in an effort to maintain that "swing" until physiotherapist Robson Lopes gives the signal to rest. The movement may seem tiny to those who spent their childhood and most of their youth between pirouettes and jumps in artistic gymnastics, but today, every advance is an achievement. "I have a notion of what's real, but I still have my dreams, my hope of running after them, of trying to get a movement back, even if it's from my arm, anything," she tells BBC Brasil. Laís lost all neck movements in the 2014 accident because of a C3 cervical spine injury. And despite the few "certainties" that medicine brings to her case, she stands firm in the hope of moving again: "I don't want to adapt to the wheelchair at all. I want to do the opposite: get out of it. "That's why Laís goes to physical therapy every day, even when she's out of Ribeirão Preto. And that's why the former gymnast today unfolds, giving events and lectures all over the country, in an attempt to bear the high costs of her new reality, which exceed R\$ 20 thousand per month. A simple pee, for instance, costs for Laís \$ 3,20 - the price of the probe she uses for this -, which makes her try to "control" her going to the bathroom in order it doesn't surpass six per day. "It is very expensive. It has since (spent with) probe to make pee and poop, the medicines, plus the people who take care of me - this is the most expensive part. Some trips I have to take for treatments, physical therapy, college...", he says. "I use five to six probes a day. If I go to a happy hour, for example, I'll give PT (total loss, slang for when you drink too much)", he jokes. "In general, every four hours, I should use a probe. But I keep policing myself and paying attention to the moment of peeing, because you have to find an adapted bathroom, a clean bathroom and you don't find...". The lack of adapted toilets and the high costs of living in a wheelchair were some of the difficulties Laís Souza has encountered since returning to Brazil after spending six months in a hospital in the United States. It was on her return home that she encountered the first obstacles of her new reality, which went far beyond bumpy sidewalks and the scarcity of ramps. "I arrived here and I wasn't going home. The chair wouldn't pass," she said. The former gymnast had to spend some time at her brother's house until she got an apartment adapted for her. It took a little time, by the way, for Laís to realize that life "adapted" in Brazil for a person with disabilities would cost a lot of money - to afford everything, she had to count on the help of many people. "It's hard (to pay for everything). But I have several angels in my life. Today I have a sponsor, who helps me a lot. I also have a government help, which I use all with medicine. And there's Neymar, who helps me with my home in São Paulo, the clinic I'm going to help me too. The knight Doda Miranda helped me a lot in the beginning too. "The disability pension she receives from the federal government is a little more than R\$ 4 thousand, which she spends on at least five medications she takes a day. The expenses are everywhere: from the caregivers, who help her to do everything every day (there are two of them), the college, the expenses with treatment and physiotherapy, to the very chair that takes her and brings her from everywhere. "The chair alone cost R\$ 23 thousand. Her wheel is like a car wheel, it's very expensive. When it hurts, I try to change the inner tube, but if it hurts the tire, it has to change, just like a car. "All this is no luxury for Laís - it's the basics she needs to keep living. "My disability is too great. If it's in any car, I can't



go, if it's a sidewalk with a giant hole, we have to do something to get around the hole. So the adaptation is still very difficult".

### Recovery

Lais's "adaptation" to his new life began when he woke up in the hospital with the news that he "could hardly breathe alone again," as one of the doctors told his mother. She did it - she had to relearn how to do it, as well as how to speak, after spending months in silence. Today, she has a perfect diction, keeps the same optimism as before - even admitting to having bad days from time to time - and uses her head to point out the things she wants or needs. When a strand of her hair insisted to rest in her eye, she made signs with her neck and asked one of her helpers, Willian Campi, to remove it. When she was thirsty, she pointed to the filter room and said: "Let's have some water? Lais's life is like this now: always asking for things for someone. This has already bothered her a lot, as well as the expenses to pay sometimes weigh, and the discouragement for not being able to even move her own chair takes care of her. "I don't like to keep asking for things all the time. When I had to eat, I would ask for someone. Then, nothing came the way I wanted, because it was someone else who was doing it. But now I've learned the way to talk, the way to show, to do," she says. "I went from a lot of extreme movement to no movement at all. This time of adaptation, of hospital, was very difficult, but until today it continues. I couldn't understand it. Because I didn't have a finger left (that moves). That didn't get into my head. Until I understood. I stopped asking myself why and went to live".

### Evolution

Little by little, Laís has been able to evolve in physical therapy. During the exercises, you can see the tiredness in her eyes, but she does not stop. This year, the former gymnast managed for the first time to sit on the floor with the support of her own hands. Standing with the help of equipment was also another recent achievement. With the help of the physiotherapists, she is lifted from the sofa and remains upright for the next exercise: a few headbutts from one side to the other on the ball that awaken the feeling of being free of the chair for a few seconds. Laís has even "taken a walk" around the room being led by Robson. Even so, three years after the accident, Lais sees himself as a lucky woman. "I get a lot of messages from people in a much worse situation than mine. I want to do everything to help these people. But as much as I have the structure that I have today, I still lack. Imagine for them." "I'm very happy when I get something in physical therapy. But I'm very demanding. As long as I don't have a real movement, I won't be satisfied. I think maybe that's why I don't stop. I've been trying to make an effort, to train myself to get out (of the chair). Because after the first time I move this hand, I'm going to do several things," he says, releasing a laugh of anxiety for this moment. "In fact, right now we're here talking, and I think my hand is moving. It's not. But the feeling is that it is. Laissez-faire optimism, for now, comes less from a concrete prognosis and more from his determination to change his reality. She goes to the doctor three times a year and constantly follows the advances in medicine to reverse pictures like hers, but, in the simplest attitudes, she keeps her thought of putting into practice what is already engraved on a tattoo on her arm: "First, I wake up, and then I try to move my arm. It doesn't move. But then I put on a song and I start a different day. I'll leave a slipper on the side of the bed for when I get up".



**TEXT 02** - Interview granted on November 10, 2017, for the Globo Esporte Ceará, with the athlete Laís Souza, with the former Brazilian Olympic gymnast. Available at: <https://globoesporte.globo.com/ce/noticia/lais-souza-sonha-em-mexer-os-bracos-e-quer-montar-clinica-especializada.ghml>>

"Laís Souza dreams of "moving his arms" and wants to set up a specialized clinic"

"Ex-gymnast was in Fortaleza to give a lecture and spoke again about the chance to become an athlete of bocha. This week, she posted a video in which she headed a ball".

"During the interview, a strand of hair descended on Laís Souza's face, separated from the rest. She patiently answered all the questions without seeming to bother with him. At the end of the interview, the former gymnast was asked to close her eyes and tell what was the first image that would appear in her mind. - I swear I was moving my arms. For example, he has a strand of hair on my face. I would take it off. I see myself brushing my teeth or taking a good bath, who knows. Or maybe, I would run madly along the beach - he said, containing the emotion with the dream that he never made a point of hiding: to be who he always was. Although she likes and has learned a lot from who she is now this week, Laís Souza posted a video on her social networks. In it, with the help of equipment, she manages to stand up and head a ball in her physiotherapy session. She challenged her friend Neymar and sent a message: "Keep training, I'm coming". And this routine of shared activities with her followers gives her more strength so that she doesn't give up and follow firmly. - Look, the messages I receive giving me strength are very important. They make me have more strength to continue every day. An example of overcoming, even for physiotherapy professionals, Laís tells us that she has one desire: to set up a specialized clinic or an institute that combines therapies for the body with psychology. Because, finally, the mind also has its wounds that need healing. And her wounds heal little by little, with each evolution or even with the examples of life she finds in her lectures in the country. - I want to help with my experience, with what I have learned since I came to the chair - he said. Laís Souza may even be away from sports now. But he has not given up on it. After meeting the paralympic boccia, in Rio de Janeiro, in 2016, she is considering starting to practice the sport and, who knows, be at the Paralympic Games of 2020, in Tokyo. The former gymnast is in the BC3 category, for athletes who need help positioning the chair and playing the ball. - I met the bocha in Rio, during the Paralympic Games, and I was very interested. Then I started to consider that it could be a sport for me. And, who knows, I'm not there in 2020, competing? Laís Souza was in Fortaleza to give a lecture on "physiotherapy and overcoming". For about an hour, she told her life story and how she has been overcoming difficulties every day since she suffered the accident that left her quadriplegic in Sochi, Russia, when she was training air skiing for the 2014 Winter Olympics".

**TEXT 03** - Interview granted on February 08, 2018, with the athlete Laís Souza, former Brazilian Olympic gymnast to the site "Veja". Available at: <https://complemento.veja.abril.com.br/primeira-pessoa/lais-souza.html>>

"I stopped looking for explanations"

"Lais Souza, 29, gymnast who became quadriplegic after skiing accident in January 2014".

"It's been four years since my accident in Salt Lake City, USA. At first I wondered a lot about what happened. I asked God: why didn't He leave me the movements of one hand, or even one finger? I kept massacring myself. But it didn't work, I couldn't find the way out, it was worse, a waste of time. The beginning was very complicated, because I left home at 10 to live the athlete's dream, and I didn't have so much coexistence with my relatives anymore. Suddenly I return to Ribeirão Preto, without any movement, needing everything and needing an adaptation for me and the whole family. I was always very independent, I had my house, I paid my bills, I had my relationships. And suddenly I saw myself in a diaper, with my mother, as if I had become a child again. I stopped looking for explanations, and a lot of things changed in my life. My way of thinking, of seeing things, the relationship with my family. Today the worst thing that could happen to me would be losing my parents. A thousand times worse than my accident. My mother is a warrior, she shows a strength that I don't know if I would have. I think I'm much more sensitive than when I was walking. When I see a child starving or having problems like mine, it makes me very sensitive. Every day they tell me stories on social networks and I realize that sometimes my problem isn't even that big. But I hardly cry, I think it's bad. I grew up in the selection of gymnastics with rigorous trainers, I suffered a lot to train, with the shin injured, broken foot, I had to learn how to deal with it, I acquired a side half "horse". I'm also more serious about everything, health, problems. I think I'm feeling old, I'm almost 30 years old! But there are days when I'm like before, playful. Sometimes I'm strong, sometimes I'm "chicken", it depends, more patient, but sometimes I burst, inevitably. I'm not one to scream a lot or make crazy decisions, unless they've been in my head for a long time. Sometimes I wake up and think I'll move normally. This frustrates me... When I talk, I have the clear feeling that I am gesturing. At first, I asked myself a lot about what happened. I asked God: why didn't He leave me the movements of one hand or one finger? I kept massacring myself" I fill my time with my work, I give lectures and events, my main source of income. The constant physical therapy makes me feel like an athlete, because I am still an athlete. I tire in the same way, I make a similar effort, I feel muscle pain, that feeling of victory when I can complete a new exercise or when I present sensitivity somewhere. After the accident, I thought it would no longer surprise me, to feel adrenaline, but life showed me that this is still possible. I have sensibility under my foot, in my belly, on my back and on some points of my hand. The muscle in my biceps also vibrates a lot in the exercises, this is new. I feel stronger, but I go slowly. I can live normally within my limitations. To be honest, what I miss most is sex. I have always been a very physical person, I was always in movement, releasing adrenaline. Today I can't do anything else, it's very difficult. As a matter of fact, my sexuality was very commented on, it didn't even bother me, because my family, which really matters, already knew. I never hid anything from my mother. Soon I told her, explained what I was feeling and we adapted. When the news came out (that I had a girlfriend), I thought: Gee, I broke my neck, I'm almost dying, and people are worried if I like man or woman in the 21st century? Now I live in Ribeirão Preto, with my mother, in a small apartment, and my routine starts after 9:30. I don't like to wake up early, I take care of my hygiene, take a bath, have lunch, then train, go to college (of psychology) and try to go out with my friends, one of them Daiane dos Santos (also gymnast), with whom I have a lot of contact. At that stage, when I see a gymnastics test, I don't feel sad, but I miss it. Today I look at the accident in a more serene way - I never went back to the place, but I intend to, it would be nice to see snow again. And I would have the chance to ski, sitting, in an adapted sleigh. I hope I don't have any trauma.

**TEXT 04** - Interview of Professor of the Physical Education post-graduation nucleus of the Institute of Educational Development (IDE) \*Humberto Gomes granted on October 6, 2017 to the Revista de Pernambuco "Algo Mais".

Available at: < <http://revista.algomas.com/bem-estar/algomas-saude/a-importancia-da-atividade-fisica-para-deficientes-fisicos>>

"The importance of physical activity for the disabled"

October 11 is the Day of the Person with Physical Disability, a date to discuss the importance of accessibility and social inclusion. Health professionals also take advantage of the day to remember about the importance of physical activities for these people, since many, because they have some kind of motor limitation, end up thinking that sedentarism is a consequence. According to the professor of the Physical Education post-graduation nucleus of the Institute for Educational Development (IDE) \*Humberto Gomes, not moving can even accentuate even more the effects of motor limitation. "The paralytic, as one example, spends most of his time sitting down, so blood circulation to the lower limbs may be compromised, accentuating the risks of vascular diseases. According to the professor, another aspect to highlight is that in many cases the increase in body weight can be observed, leading to deleterious effects caused by overweight and obesity, such as increased levels of LDL cholesterol (bad), increased blood glucose (blood sugar) and joint pain. Among the compromises caused by sedentarism is that, depending on the physical deficiency, a corporal unbalance (misalignment) is observed, a situation observed in some pathologies. "In this case, there may be the development of diseases related to the osteomioarticular system, which encompasses the bones, muscles and joints) leading, generally, to back pain. Thus, the recommended strengthening of the muscles of the upper limbs and trunk region, more currently called CORE, are strategies that should be adopted", explains Humberto. The IDE professor also reminds that, when dealing with cognitive deficiencies, mainly related to the learning process, the sedentary attitude is more harmful to the process of formation and strengthening of interpersonal relationships. Therefore, the ideal would be for the physically challenged to be accompanied by a multidisciplinary team, including physician, physiotherapist, nutritionist, psychologist and physical education professional so that these professionals can seek and discuss the different forms of intervention. "Among the activities performed by a Physical Education professional that can help improve the patient's quality of life, playful, recreational, sports and high performance physical activity, as Brazil has been standing out as a Paralympic power," explains the IDE teacher. According to data from the Brazilian Institute of Geography and Statistics (IBGE), it is estimated that Brazil has 6.2% of its population with some type of disability. Public policies for inclusion in the country are still precarious, and the cities are far from ideal accessibility. But the teacher's tip is that the person first seeks to overcome in different dimensions, such as behavioral, emotional and physical among others. "Thus, physical exercise arises for many handicapped people as a support, especially for those who became handicapped after an accident". Physiotherapy, another great ally, comes to harmonize muscles and joints, with the objective of making movement as functional as possible, according to Adriana Maciel, coordinator of the graduate program in neurofunctional physiotherapy at the Institute for Educational Development (IDE). "I usually say that every treatment has to have a beginning, middle and end. And in the case of neurological patients, even when the functional goals are reached, it is interesting that the patient goes through monthly reviews, just for follow-up, but always depending on the type of

pathology presented". According to the physiotherapist, movement is life. "Therefore, move a lot, in the minimum activities of daily life, respecting, of course, the limitations of each one. Besides, I remember to ally with a healthy diet for health and well-being".

**TEXT 05** - Interview of the technician of the Flemish delegation of Artistic Gymnastics who became paraplegic after an accident, granted on March 25, 2012.

Available at: < <http://sportv.globo.com/site/programas/sportv-reporter/noticia/2012/03/ha-14-anos-na-cadeira-georgette-diz-que-apoio-das-ginastas-foi-essencial.html>>

"14 years in the chair, Georgette says support from gymnasts was essential"

Technician, who became paraplegic after a bus accident with the Flemish delegation, sought in the sport the strength to go around".

Georgette Vidor was one of the coaches responsible for revealing several athletes, among them Daniele Hypólito and Luisa Parente. In May 1997, the coach was traveling to a competition in Curitiba, together with the delegation and the gymnasts. During the dawn, the driver of a wagon lost control and hit the red-black bus on the Presidente Dutra Highway, in the state of São Paulo. Six people died and 14 were injured. Georgette was 39 years old and was sleeping at the time of the accident. The coach suffered an injury to her marrow and spine that left her chest paralyzed. Without the movement of her legs, the trainer searched the sport for strength to go around. And the gymnasts, her students, were fundamental in regaining self-esteem. - They are 14 years in the chair. The respect of my gymnasts with me, even with a disability. I think that made me say it like this: 'They believe in me, even I here in the wheelchair'. That was very important - he said in an interview to 'SporTV Repórter'. In his career, Georgette prepared and taught several athletes to perform the movements of artistic gymnastics with perfection and lightness. In a country with no tradition in sports, the coach achieved the feat of taking gymnasts to three Olympics and three Pan-Americans. But the biggest challenge of her career came after 1997. How to conciliate the life of a coach on top of a wheelchair? Georgette remembers every step of the difficult journey. - I had never stayed in a wheelchair giving training. One day I was with a water bottle and an athlete of mine, Jessica, did the wrong thing there, on the beam. And I yelled, 'Do you want to stretch this leg? If you don't stretch, I'll throw you this bottle of water. Then they say that a coach looked at the other and said, 'Oh, she's back! It's Georgette again' (laughs). Four months after the accident, Georgette was already watching the gymnasts at the competition site. It was just a matter of time before the coach returned to her duties and started her life again. At the beginning of 1998, she took over the gymnastics of Flamengo. In 2002, she founded the NGO Qualivida and the Project "Sport for All". Today, the initiative attends around 2000 children between four and 17 years old.

**TEXT 06** - Interview granted by former gymnastic technician Georgette Vidal to the G1 site on December 19, 2014.

"Accident victim, Georgette Vidor vibrates with Lais Souza's "victories""

Coordinator of the Brazilian women's gymnastics team praises the youthfulness of the team during recovery: "Seeing her like this, with so much desire, gives enormous hope".

Seeing Lais Souza smiling and back to Brazil moved Georgette Vidor. Each advance in the young woman's frame is celebrated in double by the coordinator of the Brazilian Gymnastics Confederation (CBG) women's team, who has known her for many years. After the ceremony of the Olympic Brazil Award, on Tuesday, she spoke about the chance to see Lais again on her return and recalled that the two had already met in May, when she went to visit her during her treatment in Miami. A road accident, in May 1997, left Georgette paraplegic. - The fact of having Lais here is very special. She was a great gymnast of ours. I was with her in May, and seeing her like this, so willingly, having results, gives a huge hope. I lived this in proportions, even because one thing is at my age. Apart from being a paraplegic, I have part of movements - said Georgette.

Lais had been performing a pioneering stem cell treatment in the United States. She has been in Brazil since Saturday. She disembarked next to doctor Antonio Marttos Jr., her mother and a caregiver. On Monday, she granted a press conference in Rio and reported progress on the board after a pioneering stem cell treatment. - We talked a lot when I was in the United States. I talked with her mother. Kind of to prevent the difficulties that would come. Because they come in everyday life and they are not easy. She is a young woman. At the same time that she has the enthusiasm, she feels. After all, it is something very serious that happened in her life. What I always tried to talk about is that she has to be prepared," she said.

## **6. Categories**

According to Bardin (2011) apud Silva (2017), it is through categorical analysis that the fragmentation of work into grouped categories is represented. The author points out that one of the best alternatives is the choice of exploration by categories when one wants to study principles, beliefs, behaviors and concepts, through qualitative data. In this way, the interpretation of the data was made by the method of content analysis.

After the material was checked and properly read, the exploration was performed through cataloguing or systematization. This occurs because of the reoccurrence of terms, were constituted in documentary elements, in order to perform the gradual classification. For each category described below, the use of the subject to which the study is proposed is observed.

### **6.1 Category: Life Before Injury**

M1 - The beginning was very complicated, because I left home at 10 years old to live the athlete's dream, and I didn't have so much coexistence with my relatives anymore. I was always very independent, had my house, paid my bills, had my relationships (T3).

M2 - I talked to her mother. Kind of to prevent the difficulties that would come. Because they come in everyday life and they are not easy. She is a young woman. At the same time that she has the enthusiasm, she feels. After all, it is something very serious that happened in her life (T6).

The life before the injury is an independent life, like that of the athlete Laís Souza who had an emancipated life, because she was already in search of her dreams since she was a child, so she didn't depend on her parents, neither financially nor physically because she didn't depend to move around.



### **6.2 Category: self-view of a person with a disability**

M1 - "I don't want to adapt to the wheelchair at all. I want to do the opposite: get out of it". (T1) - Laís Souza

M2 - "At first, I wondered a lot about what happened. I asked God: why didn't He leave me the movements of one hand or one finger? I kept massacring myself" (T3) - Laís Souza

M3 - First headline of the site, in prominence: "I stopped looking for explanations" (T3) - Laís Souza

M4 - "It changed everything in my life...I depend entirely on people...I lost things I liked so much to do...(T5)

M5 - I had never stayed in a wheelchair giving training - Ex-technician Georgette.

Faced with the macroviews presented, the first look before the present limitations is the acceptance, to accept oneself as a person with disability. It is to face the reality of a different life, a new reality. It is to live together in the face of dependence on the other. It is to face oneself and face a new world.

### **6.3 Vision on the importance of physical activity practice**

M1 - There was a great national commotion that gave me visibility today I work with an NGO in 9 cities of Rio de Janeiro and we already have 18 more poles of gymnastics. I started to do work to popularize gymnastics and I'm part of a radio program... The sport teaches to overcome difficulties...(T5) - Ex-technician Georgette.

M2 - "The paralytic, as one example, spends most of his time sitting down, so blood circulation to the lower limbs may be compromised, accentuating the risks of vascular diseases" (T4) - Physical Education post-graduation nucleus of the Educational Development Institute (IDE), Humberto Gomes

M3 - "Thus, physical exercise arises for many handicapped people as a support, especially for those who became handicapped after an accident" (T4). - Physical Education Postgraduate Center of the Educational Development Institute (IDE), Humberto Gomes

M4 - I met the bocha in Rio, during the Paralympic Games, and I was very interested. Then I started to consider that it could be a sport for me. And, who knows, I'm not there in 2020, competing? (T2) - Laís Souza

M5 - Without the movement of the legs, the coach sought in the sport the strength to go around (T5).

Journalist (interviewer): "Health professionals also take advantage of the day to remember about the importance of physical activities for these people, since many, because they have some kind of motor limitation, end up thinking that sedentarism is a consequence (T4).

Physical activity for people with disabilities is very important, due to the many benefits it brings, psychic, physical, motor, cognitive. It is to feel that one can accomplish something, it is to challenge oneself, to overcome the barriers and limitations brought by the disability. It is to overcome oneself. It's to feel pleasure in something that feels good to you. And as in the Professor's opinion, it is a support for the person with disability.

### **6.4 Difficulties with accessibility**

M1 - But I'm policing myself and paying attention to the moment of peeing, because you have to find an adapted bathroom, a clean bathroom and you don't find ..." (T1)



M2 - "My disability is very great. If it's in any car, I can't go, if it's a sidewalk with a giant hole, we have to do something to get around the hole. So, the adaptation is still very difficult". (T1)

The difficulty encountered today for the person with disability is great. Most public places, as well as private places, do not offer adequate conditions to meet the needs of a person with disability, although several laws are found on the subject, such as the 1988 Federal Constitution, which guarantees it in its Article 227, Item II, second part: "[...] facilitating access to collective goods and services, with the elimination of architectural obstacles and all forms of discrimination". In this sense, ABNT NBR 9050 (2015) presents the concept of accessibility, as a condition of reach, of movable spaces, urban equipment, as well as installations open to the public, of public or private collective use, by people with disabilities or reduced mobility. Moreover, there is another important law that supports these rights, such as the Statute of the Person with Disability (Law No. 13.146/2015), but unfortunately little fulfilled.

### **6.5 A Glance at Hope**

M1 - "Look, the messages that I receive giving me strength are very important. They make me have more strength to continue every day" (T2).

M2 - "I have a notion of what is real, but I continue with my dreams, with my hope of running after, of trying to recover a movement, even if it is from the arm, something" (T1).

M3 - "They believe in me, even I here in the wheelchair. That was very important" (T5).

M4 - "The fact of having Lais here is very special. She was a great gymnast of ours. I was with her in May, and to see her like this, so willingly, having results, gives a huge hope" (T6)

M5 - "The hope for healing is very great. But it also has to follow life as if it wasn't going to happen. If it happens, it will be a wonder. But if it doesn't happen, you have to prepare yourself. I was very excited with what I saw". (T6)

People with disabilities, even after the traumatic spinal cord injury, even after the life that is now different and new to them, keep the flame of hope. The one who is still believed, or who can be believed to change. It is what still gives them strength to believe that there is a possibility to change the reality they are in. And not only the disabled people themselves who believe in themselves, but also as in the case of coach Georgete (T5), where the students themselves believe in her and make her feel that trust, this also encourages her and makes her go on.

## **7. Final considerations**

Discourse analysis is not about being a method, but about being a critical point of knowledge, of rigorous analysis, which should reach everyone. And yet, how important is knowledge and learning as to communication. It is relevant to note the effect in which it can have the power of discourse, in which its analysis is applied to visual and written texts. In this study, it was critically analyzed the speeches of people with disabilities, and of people who are involved with them. It was analyzed before macrovisions what stood out among all the texts, distinct by categories that expressed each moment of the spinal cord injury. "In casu" took care of presenting interviews with a former athlete, with a gymnastics trainer who is also a person with disability, and a physical education teacher specialized in studies of traumatic injuries like

these people. What was demonstrated through the macroviews of these interviewees is how they lived before the injury in being independent; how they live and react after the injury or accident, in a different world through dependence on others; how they feel hope to walk again, and especially learn from the new, with the difficulties faced by the lack of accessibility, making a correlation with the paralympic sport and the possibility of physical activity for people with disabilities.

## 8. References

- ALGOMAI, the magazine from Pernambuco. The importance of physical activity for disabled people. Available at: <http://revista.algomais.com/bem-estar/algomais-saude/a-importancia-da-atividade-fisica-para-deficientes-fisicos>>. Access on: 07 Nov. 2018.
- BARROZO, Amanda Faria et al. Accessibility to smart, culture and leisure for people with disabilities. *Cadernos de pós-graduação em distúrbios do desenvolvimento*, v. 12, n. 2, 2018.
- BEGOSSI, Tuany Defaveri; MAZO, Janice Zarpellon. The process of institutionalization of sport for people with disabilities in Brazil: a federal legislative analysis. *Ciência & Saúde Coletiva*, v. 21, p. 2989-2997, 2016.
- CRAGG, Jacquelyn J.; STONE, James A.; KRASSIOUKOV, Andrei V. Management of cardiovascular disease risk factors in individuals with chronic spinal cord injury: an evidence-based review. *Journal of neurotrauma*, v. 29, n. 11, p. 1999-2012, 2012.
- GLOBO. Sport TV Reporter. Available at: < <http://sportv.globo.com/site/programas/sportv-reporter/noticia/2012/03/ha-14-anos-na-cadeira-georgette-diz-que-apoio-das-ginastas-foi-essencial.html>>. Access in: 07 Nov. 2018.
- GODOY, Priscila Samora et al. Correlation between functional classification, gender and motor skills of wheelchair handball players. *Revista Brasileira de Ciências do Esporte*, v. 39, n. 4, p. 424-432, 2017.
- MILK, Roberto. Globo Esporte Ceará. Available at: <https://globoesporte.globo.com/ce/noticia/lais-souza-sonha-em-mexer-os-bracos-e-quer-montar-clinica-especializada.ghtml>>. Accessed on: 06 Nov. 2018.
- LIMA, Luiz Fernandes de et al. INDIVIDUALS WITH PHYSICAL DEFICIENCY AND PARALYMPIC HALTEROPHYLISM: An ETHNOGRAPHICAL STUDY. *Revista Carioca de Educação Física*, v. 12, n. 1, p. 20-25, 2017.
- MEDEIROS, Marina dos Santos de et al. Case study of an individualized swimming program for wheelchair users with polio: analysis of biochemical parameters, quality of life and functional physical capacity. *Revista Brasileira de Ciências do Esporte*, v. 40, n. 1, p. 94-99, 2018.
- MENDONÇA, Renata. BBC News Brazil. Available at: < <https://www.bbc.com/portuguese/geral-41543877>>. Access in: 06 Nov. 2018.
- BIRTH, Silvio; CASTRO, Luiz. See. Available at: <https://complemento.veja.abril.com.br/primeira-pessoa/lais-souza.html>>. Accessed on: 06 Nov. 2018.
- NOGUEIRA, Conceição. Discourse analysis(s): different conceptions in social psychology research practice. *Psychology: theory and research*, v. 24, n. 2, p. 235-242, 2018.
- VAN DIJK, Teun A.; MEDEIROS, Breno Wilson Leite; ANDRADE, Maria Lúcia CVO. A critical analysis of multidisciplinary discourse: an appeal in favor of diversity. *Linha D'Água*, v. 26, n. 2, p. 351-381, 2013.
- SCHOELLER, Soraia Dornelles et al. Changes in the lives of people with acquired spinal cord injury. *Revista Eletrônica de Enfermagem*, v. 14, n. 1, p. 95-103, 2012.
- SILVA, Everton Rodrigues da; GONÇALVES, Carlos Alberto. Possibilities of incorporating the critical analysis of Norman Fairclough's speech into the study of organizations. *Cadernos EBAPE. BR*, v. 15, n. 1, p. 1-20, 2017.
- TORRI, Danielle; VAZ, Alexandre Fernandez. Paralympic sports: difficult inclusion, technological incorporation, competitive bodies. *Práxis Educativa*, v. 12, n. 2, p. 19-33, 2017.

# **ANALYZING THE APPLICATION OF THE EQUALITY CONCEPT TO INDIGENOUS STATUS IN RELATION TO HUMAN RIGHTS**

**Cristiane Martins Viegas de Oliveira**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Leandro Rachel Arguello**

Local Development Doctorate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Diego Bezerra de Souza**

Local Development Graduate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Antonio Carlos Dorsa**

Local Development Doctorate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Raphael Ricardo de Jesus Portela**

Local Development Doctorate Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Aline Ortega Soloaga**

Graduate Program of Movement Sciences, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Raquel Borges de Barros Primo**

PhD in the Health Sciences Graduate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**Geanlucas Mendes Monteiro**

Health and Development in West Central Region Graduate Program, Federal University of Mato Grosso  
do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Flávio Henrique Souza de Araújo**

Health Sciences Doctorate Program, Federal University of Grande Dourados  
Dourados, Mato Grosso do Sul – Brazil.

**André Luiz Dias**

Law Degree, Federal University of Bahia  
Salvador, Bahia – Brazil.

**João Vitor Alves dos Santos**

Local Development Mastering Program, Dom Bosco Catholic University  
Campo Grande, Mato Grosso do Sul – Brazil.

**Gildiney Penaves de Alencar**

Master Degree of Health and Development in West Central Region, Federal University of Mato Grosso do Sul  
Campo Grande, Mato Grosso do Sul – Brazil.

**Abstract**

*This article is about the Statute of the Indian from the educational point of view of equality. It aims to approach one of the branches of social rights, regarding education. This education is protected by the 1988 Constitution of the Federative Republic of Brazil and must be provided on an equal basis for students of basic education and indigenous academics. It is a fact that traditional populations, from basic education, receive an education in a different way, because of their language, customs. Based on this premise, the research sought to answer why offer differentiated treatment in basic education (primary and secondary) and not give the necessary support in higher education? In this context, we sought to get to know the reality of the indigenous peoples in terms of education, from the first steps until they entered the University. In addition, factors were pointed out that make it difficult for these scholars to remain in universities and the possible ways to attenuate the existing discrepancies in education and opportunity between indigenous and non-indigenous people. The methodology applied was the bibliographic review, with the use of books, legislation (especially the Statute of the Indian) and articles hosted in online journals. The results showed that despite the advances, there is still a long way to go to achieve an ideal education.*

**Key Words:** Education; Public Policies; Indian Statute; Human Rights.

**1. Introduction**

The Brazilian indigenous population, with the coming of the Portuguese Crown to Brazil, underwent countless asylaxationist processes that sought the integration of this community with the rest of the population. About 519 years later, even with the guarantee of rights and protection to indigenous peoples, they still suffer the effects of this isolationist policy, especially with regard to education.

Assimilationism, in turn, constituted the policy adopted by the colonizers in Brazilian lands, in order to transform the African peoples into Portuguese citizens, making them leave behind their roots and culture. This asyllilotic process was divided into 3 phases: 1st - the destruction of traditional societies; 2nd - the introduction of Portuguese culture and 3rd - the integration of Africans into Portuguese society.

Analogously to this, we have the asyllationism in relation to the indigenous peoples, who suffered this same process, but who, unlike the African peoples, continued to suffer the effects of this policy, even after the proclamation of the Republic.

With the promulgation of the Federal Constitution in 1988, the original populations began to mobilize so that their rights would be truly respected, among them the issue of education that should take into account their cultures. From that moment on, laws promising the protection of indigenous peoples emerged, despite the growth of practices aimed at extinguishing their culture.

Indigenous school education is governed by the Statute of the Indian, in its Arts. 47 to 52, which indicate ideal ways for these peoples to have full access to education, without alienating them from family life, and without leaving behind language and customs. Despite this, the reality that has been seen is an education far from the ideal, especially when it comes to higher education, in which there is a clear discrepancy as to the opportunities when compared to other indigenous academics. This neglect results in a polarized country, economically speaking, and unequal in social terms.

It is in this context that the Brazilian indigenous population is inserted, facing the existence of promising laws, but that the fight against inequality has not yet been effectively propagated; or rather, that it has not been sufficiently respected.

The general objective of this work is to address one of the main fundamental rights presented in Article 6 of the Constitutional Charter, namely education, viewed from the perspective of equality before the indigenous population with regard to human rights. In specific terms, it intends to present the difficulties faced by Indians when leaving their communities and to verify the real opportunities for Indians to enter universities.

Finally, the relevance of this debate will be presented, as well as the educational stages of indigenous populations and the public policies created so that they can consolidate themselves in higher education.

## **2. The first steps in indigenous education: From the arrival of europeans to the current indigenous school structure.**

Until the 1970s, indigenous education was guided by catechism in order to assimilate the culture of Brazilian society. The idea was to integrate and civilize the indigenous, who from the point of view of Western Christian culture, came from an inferior and little developed culture. This was confirmed by the fact that the official guardianship agencies, the then Service for the Protection of the Indian (SPI) and later the National Indian Foundation (FUNAI) - signed an agreement with religious organizations of various faiths, so that they would be in charge of implementing school work within the villages and indigenous communities (INEP, 1994).

In this initial analysis it is essential to define the concept of equality. The 1988 Federal Constitution, in the bulge of article 5, brings the issue of equality, explaining that "everyone is equal before the law. The doctrine, in turn, divides this equality into two: material and formal. In this case, equality is material equality, that which, according to Aristotle, is "to treat the equal and unequal equally, to the extent of their inequalities. Thus, unequal treatment is allowed when it comes to different circumstances/individuals. In practice, we see the action of this article in granting, for example, benefits to the elderly, children, the

disabled, etc.

Based on this premise, it is intended to punctuate equality in relation to the education offered to the indigenous population. It is not a question of providing the same treatment offered to other students; it is a question of balancing this treatment so that, in the end, all academics can have the same opportunities of a professional career.

From the first contact with education, the indigenous peoples were hostages to discriminatory and repressive practices, which aimed to curb any means of spreading their culture and, consequently, their own identity. Discussing quality indigenous education has become important because it is essential to value indigenous knowledge and know-how, making them protagonists.

Markus (2006, p. 56) conceptualized indigenous education as "

[...] educational processes specific to indigenous societies that include pedagogies, ways, methods, and specific rules of teaching and learning, which guide all life in this society. Indigenous education, therefore, does not consist only of schooling; it is an education produced and transmitted by the indigenous community itself, where the teacher is an active participant and responsible for teaching not only the school's programmatic content, but also for teaching the customs, traditions, religious practices and all the elements that foster cultural identity.

According to data from the IBGE (2010) census, there are about 305 ethnic groups in Brazil, which implies that each community follows its own culture. Therefore, when referring to indigenous school education, it is essential to understand it in the context of each culture, whose multiculturalism makes it impossible to standardize a curricular grid.

Soratto (2007), Belz (2008), and Cruz (2009) divided the history of indigenous school education into four phases, namely: 1) colonial Brazil; 2) creation of the Indian Protection Service (SPI), which was later replaced by FUNAI in 1967; 3) formation of non-governmental organizations and indigenous movements initiated in the 1960s and 1970s (military period); and 4) the initiative of the indigenous themselves to manage and mediate the processes of school education.

Still according to the authors mentioned above, the first contact of the indigenous with school education began in the colonial period, when the colonizers sought to intronize into the communities, ideas and customs from Europe and Christianity. According to Novaes (2011), the Jesuit missionaries were the first to undertake this task. The idea was precisely to adapt these peoples to the Portuguese reality of the time, aiming at the incorporation of indigenous labor into Brazilian society; however, the attempt to catechize these indigenous peoples remained flawed, since there was a lack of interest in learning the Christian culture. Even, according to Novaes (2011), there was a strong influence of this fact, with the transfer of African slave labor, precisely because of the difficulty of catechizing these peoples.

After that, the second phase began, which was the creation of the Indian Protection Service (SPI), created on June 20, 1910, giving way to the body that currently deals with issues pertinent to the indigenous population, which is the National Indian Foundation (FUNAI) created on December 5, 1967. It is important to point out that just the fact of speaking of an agency that would act in defense of indigenous interests has already meant a great step towards respect for diversity in the country, since at the time there was little talk about the rights of indigenous peoples. In the transition from one phase to the next there was a fact of great



relevance that can be pointed out as the kick-off for this new phase: in the middle of the 18th century the first indigenous legislation was created. After Marquês de Pombal expelled the Jesuits from Brazil, he noted a need to protect the indigenous peoples from their influence, thus proclaiming, in 1755, the emancipation of indigenous peoples. After that, the schools were replaced by strategic classes (public and secular education system) and administered by the Directory of Indians (SECO, AMARAL, s/d online).

The retro change referred to was ineffective because 53 years later, with the arrival of the Portuguese royal family in 1808, D. João dictated new directions for these peoples; one of them, for example, was the permission for the settlers to enslave the indigenous people. Despite the setback, a change in the scenario of the indigenous population is notorious because, even for a brief period of time, they could feel a change in their status, since they went from being savages without a soul, to being human beings subject to rights just like the rest of society.

The second phase of the history of indigenous school education was externally good for the indigenous population, because it brought significant changes for this population, but internally it was marked by numerous controversies. According to Ferreira (2007, p.64, highlights in the original), this phase

It is marked by the State's attempt to reformulate indigenist policy. The concern with the linguistic and cultural diversity of the indigenous peoples in the country comes on the scene. With the creation of FUNAI in 1967, there were some more significant changes. Bilingual education is chosen as a way to "respect tribal values. In 1973, by the Statute of the Indian - Law 6001 - it became mandatory to teach native languages in indigenous schools. The issue of bilingualism as a way to ensure and respect the "cultural heritage of indigenous communities". (Article 47, of the Statute of the Indian) is, however, in contradiction with the integrationist objectives of school education offered in practice by FUNAI.

Since the creation of FUNAI, together with the promulgation of the Statute of the Indian, there has been a different view of indigenous school education, especially with regard to the issue of the language worked in the classroom. On the other hand, internally this phase is full of polemics. This is because the Indian Protection Service (SPI) just before its extinction, faced a series of complaints about corruption, administrative irregularities, etc. These accusations caused the government of the time to decide to extinguish this body and create a new one, with the same attributions, but to execute the service in a different way, a fact that came with the promise of punishment to those involved and the clarification of the facts.

The creation of an agency focused on the indigenous population was of paramount importance to meet their demands, even though it was not as effective as it should have been, but it showed progress compared to previous years.

According to Ferreira (2007), the third phase had its beginning marked by the military regime. During this period, some indigenous assemblies were held throughout the country, and the issue of indigenous education was frequently discussed. In addition, the demands and mobilizations around indigenous rights have made these movements gain strength and brought favorable results to the indigenous populations. The fourth and final phase took place from the 1980s onwards, with the demands of indigenous peoples to administer and manage their education processes. For Soratto (2007, p. 54), "[...] the demonstrations and demands for recognition of difference have become increasingly strong and intense, and the indigenous school has gained space in Brazilian society in favor of their rights.

Paixão (2010) still makes a subdivision of these phases stating that the first two as the phases of non-participation, the third phase is that of induced participation and finally, the fourth as the phase of effective participation, each of which imprinted the historical context of the time and how society reacted in each period with indigenous issues.

The history of the indigenous population in Brazil shows that it was only from 1988 onwards, with the promulgation of the Federal Constitution, that the Brazilian State recognized the right to differentiated citizenship for indigenous peoples, respecting their territorial and cultural rights and their specificities.

According to the 2015 School Census, there are currently 3,085 indigenous schools in Brazil, with a total of 285,000 students and 20,000 teachers who serve about 305 ethnic groups and speak 274 different languages (EDUCATION BORATORY, 2019).

Each indigenous community has its own particularity. This does not mean that there are no communities with the same language or culture, however, it is common that there is a difference from one community to another. This could be a reason for the process to be differentiated as well. Among the specifics that the indigenous school has are: teaching in indigenous languages in addition to Portuguese; a school calendar adapted to the ritual and daily activities of each context; transmission of traditional knowledge within the school; and community participation in the decisions of the school's objectives.

It is not possible to create an indigenous school grade to be faithfully followed by all communities, because of the different calendars of each people and also because of the different languages. But it is essential to establish guidelines for this education to be implemented in the context of each community, without disrespecting the culture, as was done through the 1988 Federal Constitution and the Statute of the Indian.

### **3 The situation of indigenous school education in the context of recent research.**

Through the researches carried out, it was possible to verify the precariousness in some indigenous schools, such as: the lack of availability of government agents to solve questions about structure, didactic material, available resources, activities carried out in the classroom, insufficiency of training courses for indigenous teachers, lack of realization of the right to difference, among others.

It remains clear, however, that there have been significant advances in relation to indigenous education, if we compare the colonial period with the present moment. However, even though there are laws protecting the right to differentiated, specific, and quality education for indigenous populations, in practice we still see many challenges to be overcome. Abbonizio (2013, p. 52-3), makes the following reflection on the theme:

If the new indigenous schools were evaluated in terms of physical structure, material resources, school meals, sports equipment, libraries, laboratories, accessibility and, above all, technical-pedagogical accompaniment of the teams from the education departments, they would probably make up a picture of the most precarious Brazilian schools, as if the prerogative of being a school located on indigenous land justified their isolation and restriction to other rights.

Research done by Oliveira (2015) and Zibetti (2015), summarized in a single table, shown below, reveals

the conditions of each component element of the indigenous school system, which are: curriculum, didactic material, physical structure, functioning and organization and resources.

Table 1. Components of the indigenous school grade

CURRICULO	TOTAL	%
They bring issues related to indigenous culture	24	100
Similar to the non-indigenous school	15	62,5
Similar to the rural school	7	29,16
It includes generating themes chosen by the school, triggering dialogue with the children and their families	2	8,33
DIETARY MATERIAL	TOTAL	%
Use of the "common" textbook	11	45,83
Specifications and/or apostille	6	25
PHYSICAL STRUCTURE	TOTAL	%
Precarious schools	7	29,16
Schools with new structures	2	8,33
School that was being built and was abandoned	1	4,16
School that was demolished to be built but the works were not started	1	4,16
FUNCTIONALITY AND ORGANIZATION	TOTAL	%
Active participation of the indigenous family and community in the school	15	62,5
Non-indigenous school calendar	14	58,33
Bureaucratic difficulties arising from the government	13	54,16
Similar schedules for non-indigenous schools	6	25
Respectful relationship between teacher and students	6	25
Evasion	5	20,83
Shared and/or democratic management	4	16,66

Activities of the "school tradition" (routine, call, exams, monthly and bimonthly grades, regarding national holidays, repetition of readings, copies, individualized works, etc.)	4	16,66
Own calendar	4	16,66
Non-indigenous management	2	8,33
Indigenous management	2	8,33
Own schedule	1	4,16
Disinterested relationship of the teacher and/or the teacher with the community	1	4,16
RESOURCES	TOTAL	%
Problems in the implementation of the training courses for teachers and indigenous women teachers	7	29,16
Lack of picnic material, physical space	4	16,66

Source: BDTD survey conducted in 2014 by Oliveira (2015) and Zibetti (2015)

From these data it is possible to see that the reality of school education is now much closer to education in rural schools than to the education idealized in the 1988 Federal Constitution or in the Statute of the Indian. Belz (2008, p. 7) makes the following point, stating that, "[...] at many times, the practice of teachers reveals that the school in the village is much more similar to a rural school, since it privileges a curriculum proposal that is present in non-indigenous schools in Paraná," but seeking to escape the established standardization, teachers offer the knowledge accumulated by the Kaingang people.

In addition, other authors bring diverse accounts, which walk towards the same reality: the existing laws are promising and bring a new idea on how to conduct indigenous education. The great guiding issue is that these same laws do not leave the documentary sphere; perhaps because of the indisposition of those involved, perhaps because of the scarcity of resources. The fact is that the way this education is being conducted is far from ideal.

A work done by Cruz (2009, p. 131) showed that the Terena school had a new and masonry structure: "It has nine classrooms, a kitchen, a men's and a women's bathroom, a room and a bathroom for the teachers, a multipurpose court, a large hollow, a place of socialization and a smaller hollow in which, it seems, a library will function, both built in Mutirão and Terena style". However, the author noted that this teaching takes place in very precarious conditions, "[...] resulting in the formation of subjects with poor literacy and a committed understanding of the world. I noticed in the written records of the children their inability to use correct writing to present their ideas, regardless of their age and the year they are attending, drawing attention to this education being offered at school (CRUZ, 2009, p. 166).

The result of research done by Brito (2012, p.122) shows that the production of didactic material is small, which states that in the village of Espírito Santo, the didactic material used "[...] is composed of non-differentiated textbooks for the indigenous reality, produced in publishing houses in the Center-South of the country, and some handbooks produced with the help of CIMI.

Finally, there are countless problems faced in indigenous education. Because of the large number of indigenous communities, it may be that these problems vary from one community to another, it may be that in a certain community there is an education that follows all the molds defined in the 1988 Federal Constitution and the Statute of the Indian. This problem is recurrent and occurs in several communities, and this reality weakens education for these Indians who are beginning school life.

#### **4 The Meeting of opposites: Differentiated teaching and the constitutional principle of equality as allies in indigenous school education**

As seen previously, the Federal Constitution of 1988 brings in Article 5, in the caput, the maxim that "Article 5 All are equal before the law, without distinction of any nature, guaranteeing Brazilians and foreigners residing in the country the inviolability of the right to life, freedom, equality, security and property [...]"

In this respect, it is important to distinguish this equality. The doctrine divides this equality into two aspects: material equality and formal equality. Formal equality is that which treats equality before the law. Material equality is that in which human beings receive equal or unequal treatment, depending on their situation. The latter is the equality referred to in this work, the equality that allows differentiated treatment in order to try to smooth out some of the differences between beings and situations in society. It is in this aspect that the encounter of totally opposite facts occurs: equality and difference. It is essential that such opposing sides walk together to build a new chapter in indigenous school education.

Without these allies, indigenous school education today would probably return to the times of colonial Brazil; the only difference would be that today they would not be catechized against their own will - the result of a secular country - but it would be a schooling that would leave something to be desired, especially in terms of school calendar and bilingualism, among other aspects.

It is important to emphasize that the differentiation of education in indigenous schools is not a pretext for precariousness in education, much less a synonym for inferiority. In fact, at the time when the indigenous people began to demand differentiated education, their main concern was that the members of that community should also receive the knowledge of their peoples and have space for the practice of their customary rites.

All the significant changes in the indigenous education system are the result of two protagonisms: the Statute of the Indian, created in 1973 (Law No. 6,001) and the Federal Constitution, promulgated in 1988. At the time, the act of creating a Statute for the indigenous people was a revolutionary fact, especially in the historical context of the time. Synthesizing, in the act of creation of Law 6.001 of 1973, henceforth called "Statute of the Indian", it was a landmark that revolutionized the indigenous school education in force at that time.

## **5. Analysis of the status of indigenous people and their contribution to (dis)equality in indigenous school education**

For sure, the Statute of the Indian has revolutionized indigenous life in several factors, however, the indigenous scenario has not undeniably improved, as expected. During the period of creation of the Statute of the Indian, there were still remnants of the assimilationist policy that haunted the indigenous population for many years, especially during the colonial period. The fact that the Statute was created during a period of military intervention strongly contributed to the fact that this law was not totally focused on respect for indigenous diversity. The objective of integrating the indigenous peoples into society also stands out. It is possible to observe this purpose from the first article of this legal provision, noting the presence of the integrationist ideal: "Article 1 This law regulates the legal situation of Indians or foresters and indigenous communities, with the purpose of preserving their culture and integrating them, progressively and harmoniously, into national communion.

The question of integrationism differs from assimilationism in that assimilation would imply the loss of the cultural identity of the assimilated group, while in integration, uses, customs and traditions are not lost. In the case of the Statute of the Indian, although this law brought very important provisions in the construction of respect for cultural diversity, it still shared space with provisions within the Statute itself that revealed the intention of the rulers of the time: the intention that the indigenous should be integrated with our society. In addition, we can highlight another provision in the Statute that reveals the integrationist intentions existing at the time:

Article 4 Indians are considered:

- I - Isolated - When they live in unknown groups or have few and vague reports through eventual contacts with elements of national communion;
- II - In the process of integration - When, in intermittent or permanent contact with strange groups, they keep less or most of the conditions of their native life, but accept some practices and ways of existence common to other sectors of national communion, which they need more and more for their own sustenance;
- III - Integrated - When incorporated into the national communion and recognized in the full exercise of civil rights, even if they retain uses, customs and traditions characteristic of their culture.

It is clear that in this article the legislator's concern to label the indigenous population, possibly in order to absorb the most conservative indigenous people into society. In 1988, with the enactment of the so-called "Citizen Constitution," indigenous rights were innovated on a specific topic for them, according to Article 231 of the Constitution:

Art. 231. Indians are recognized for their social organization, customs, languages, beliefs and traditions, and for their original rights over the lands they traditionally occupy, and it is the Union's responsibility to demarcate them, protect them, and ensure that all their goods are respected.



The 1988 Federal Constitution also strengthened and guaranteed indigenous multiculturalism, respect for traditions, among other things, and this caused integrationist or asyllagistic thinking to lose its strength, so much so that the devices supported by this thought are ignored today.

Silva (2015) defines the current system of protection for indigenous peoples as a system of interaction, not integration. It is important to point out that Law no. 6,001 of 1973 is still in force in the Brazilian legal system, however, its analysis must be made in accordance with the 1988 Federal Constitution. For this reason, the provisions of integrationist or asymmetrical nature are no longer used: these provisions were not received by the Federal Constitution. Santos Filho (2005, p. 44-9) reiterates the idea stating that

[...] the provisions of the Indian Statute, Law 6.001/1973, forged under the asyllary optics, it is worth mentioning, which aimed at the total incorporation of Indians or their communities into national society, with the loss of their ethnic or cultural identity, were not received by the new constitutional system implemented since 1988.

With regard to indigenous school education, the 1988 Federal Constitution received the provision of the Statute of the Indian that ensured the proper learning processes and bilingual teaching. Let's see:

Art. 210. Minimum contents will be established for elementary education, in order to ensure common basic training and respect for national and regional cultural and artistic values.

§ 2º Regular primary education will be given in Portuguese, and the indigenous communities will also be guaranteed the use of their mother tongues and their own learning processes.

Articles 47 to 52 of the Statute of the Indian represent a summary of the main provisions on indigenous school education in verbis:

Art. 47: Respect for the cultural heritage of indigenous communities, their artistic values and means of expression is assured.

Art. 48: The education system in force in the country is extended to the indigenous population, with the necessary adaptations.

Art. 49: The literacy of the Indians will be done in the language of the group to which they belong, and in Portuguese, safeguarding the use of the former.

Art. 50: The education of the Indian will be oriented towards integration into the national communion through a process of gradual understanding of the general problems and values of the national society, as well as the utilization of his individual aptitudes.

Art. 51 Assistance to minors, for educational purposes, will be provided, as far as possible, without keeping them away from family or tribal coexistence.

Art. 52: The Indian will be provided with adequate professional training, according to his degree of acculturation.

Finally, the Statute continues to be in force normally. The Federal Constitution, as previously mentioned, received the Statute of Indio, with the exception of the laws that opposed the right to multiculturalism. It is

important to point out that the Statute itself was a milestone in the history of the indigenous population, but it had been contaminated by the interests of others that did not refer to the well-being of these peoples.

## **6. Mapping of norms on indigenous school education**

In addition to the Federal Constitution of 1988, other documents and norms guide indigenous school education, among them: the Convention and Resolution n° 169/1989, of the International Labor Organization (ILO); Federal Decree n° 26/1991; Interministerial Ordinance n° 559/1991; Ordinance n° 60/1992; Guidelines for the National Indigenous School Education Policy of 1993; Guidelines and Bases of National Education Law (LDBEN) n° 9.394/1996; the National Curricular Reference for Indigenous Schools (RCNEI) of 1998; Resolution CNE/CEB n° 3/1999; CNE/CEB Opinion n° 14/1999; Guidelines for the Implementation of Indigenous Teacher Training Programs in the State Education Systems of 2000; Law n° 10.172/2001 - National Education Plan (PNE); and Decree No. 6861/2009 (BATISTA, 2005; BERGAMASCHI, 2005; BRITO, 2012; PAES, 2002; ROSSATO, 2002; SORATTO, 2007).

According to Oliveira (2015) and Zibetti (2015), "The legal documents produced propose an intercultural dialogue, following the principles of school education, differentiated and specific for each indigenous people, considering the indigenous protagonists of the school process, with a view to achieving their autonomy.

The above documents and norms direct the reader to observe indigenous education through a critical eye, being aware of the cruel historical context through which the indigenous population has crossed and how these new norms reflect on indigenous education today

## **7. Access to higher education and new challenges**

After the promulgation of the Citizen Constitution, the demands of indigenous peoples began to grow. This is because, with the acceptance of indigenous culture, there was greater openness to enter higher education.

According to Paladino (2013), Brazil, at the end of 1990, kept indigenous higher education off any government agenda. The author said that, even though there were students belonging to the original peoples who graduated at that time - many of them leaders of the indigenous movement - at that time it was more urgent to establish basic education schools on indigenous lands.

The access of indigenous people to higher education ended up expanding because, they saw in the Universities, a path for the search of better conditions. This is what Bergamashi (2005) reveals, clarifying that

Nowadays, it is noticeable that in all the Indigenous Areas of the State, the interest of the communities and their leaders for the study of their youth is growing, perceiving the universities as a new strategic space relevant in their struggle for better living conditions and greater autonomy.

With this, a growing number of indigenous people are looking for a degree in higher education; most of them were once only in high school, but today the reality is different.

Although there has been considerable influx of indigenous people into university banks, the great impasse, and one of the greatest challenges for them, is the question of permanence. The first challenge is the precariousness of basic education, which causes these academics to enter higher education on a basis that is not as solid as it should be.

The government's disregard for indigenous schools is a relevant factor because it has an impact both in the short term - in the classroom itself in indigenous schools - and in the long term on knowledge formation, which will serve as a basis for the rest of academic life in the future.

The second deadlock detected is in relation to the very presence of indigenous people in universities. In this sense, issues related to discrimination (both of the students and of the employees themselves), bureaucracy in relation to the documents that the universities ask for, difficulty in understanding the dialogue (language, understanding of text, oral presentations), among others, can be listed. The third challenge is about the situation after the academic internship, the fate of these indigenous people after completion of higher education. Urquiza (2011), Nascimento (2011) and Espíndola (2011) report that in Mato Grosso do Sul

[...] the situation of open conflict between Indians and landowners over land ownership, aggravated by a historical relationship of exclusion and denial of indigenous culture, manifested by the prejudices that permeate the relationship with the regional environment, makes the relationship of the newly formed with the labor market difficult. How can we avoid that the passage through the HEIs does not translate tomorrow into new frustration when, after the course, they do not find work or, in other terms, continue without a place in the regional reality?

Another aggravating factor that must be taken into account is those indigenous people who live far from the universities, and for this reason they move to the city where the university is located. The reality experienced is totally different. Factors such as traffic and violence in big cities make the environment somewhat hostile and make staying at university a dilemma. In addition, the question of class attendance, required by the universities, makes staying at the academy a paradox; submitting to the university's time schedule and moving away from the way they experience time in their original culture, or rejecting this academic schedule and failing to succeed in completing the course.

Thus, a challenge for universities arises: to make the academic environment a place that goes beyond the transmission of the programmatic content of the academic degree; to make the academy an environment also focused on the constant exercise of interculturality. It is a premature analysis of facts that leave something to be desired and need restructuring, but perhaps the question of continued interculturality in the academic environment is one of the key points for the increase in the number of indigenous who enter and complete higher education.

## **8. Final considerations**

Although the advance in indigenous school education is notorious, when compared to the first access to schools, it is noticeable that there are still many challenges to be faced. The role of education in the life of the individual is the tool capable of changing a generation.

Therefore, it is necessary to take a more careful look at how this school education reaches indigenous students. The restructuring of indigenous schools in each community is essential for a more solid foundation in knowledge formation. In addition, a good education can be the watershed for the indigenous, who in the future will choose whether or not to join the Academy. In addition, it is important to rethink public policies aimed at indigenous academics in order to make their stay less complicated.

Finally, the growing numbers of academics in universities makes it the right time for universities to reflect on the type of education they offer to indigenous peoples and on ways to propagate interculturalism in the field of higher education, being aware that it is not the indigenous who must be integrated into the culture of the academic mass, but rather the academy that must develop the way in which activities are conducted, with a view to overcoming homogenizing tendencies in education.

## **9. References**

- ABBONIZIO, Aline Cristina de Oliveira. Indigenous school education as an educational innovation: the school and the future aspirations of the communities. 2013. 192f. Thesis (Doctorate in Education) - University of São Paulo, São Paulo, 2013.
- BATISTA, Teresinha Aparecida da Silva. The struggle for an indigenous school in Te'yikue, Caarapó/MS. 2005. 156f. Dissertation (Masters in Education) - Dom Bosco Catholic University, Campo Grande.
- BELZ, Karina Cristiane. Kaingang school education: from official discourse to effective practices. Florianópolis, 2008, 189f. Dissertation (Masters in Education) - Universidade Federal de Santa Catarina, Florianópolis.
- BRITO, Edson Machado de. Karipuna education in Amapá in the context of differentiated indigenous school education in the village of Espírito Santo. 2012. 184f. Thesis (Doctorate in Education) - Pontifícia Universidade Católica de São Paulo, São Paulo.
- CARLOS, Antonio. Notes on History. Portuguese colonization and asyllary politics. 2017. Available at: <https://antoniocv.wordpress.com/2017/02/03/colonizacao-portuguesa-e-politica-assimilacionista/>. Access on 20 Aug. 2019.
- CRUZ, Simone Figueiredo. The Terena child: the dialogue between indigenous education and school education in Buriti village. 2009. 195f. Dissertation (Masters in Education) - Dom Bosco Catholic University, Campo Grande.
- FERREIRA, Geraldo Veloso. Indigenous school education: the indigenous cultural practices in the pedagogical action of the Indigenous State School São Miguel - Iauaretê (AM). 2007, 207f. Dissertation (Masters in Education) - Pontifícia Universidade Católica de São Paulo, São Paulo.
- INEP- National Institute of Educational Studies and Research. In Open. Brasília. Year 14. n.63, July/September 1994. Available at: <http://portal.inep.gov.br/documents/186968/485895/Educa%C3%A7%C3%A3o+escolar+ind%C3%ADgena/9c1b748e-4e94-46a3-8e94-ac5109aaba3f?version=1.3> Accessed Aug 22, 2019
- JUSBRASIL. The Statute of the Indian before the Federal Constitution of 1988. Available at: <https://gabriel2052.jusbrasil.com.br/artigos/237423120/o-estatuto-do-indio-frente-a-constituicao-federal-de-1988>. Access on: 20 Aug. 2019.

EDUCATION LABORATORY. Available at: <https://labedu.org.br/principios-particularidades-escolas-indigenas-brasileiras/>. Access on: 20 Aug.2019.

MARKUS, Cledes. Ethnic identity and indigenous school education. 2006, 156f. Dissertation (Masters in Education) - Regional University of Blumenau, Blumenau, SC.

NOVAES, Gabriela Pontin Novaes. A reflection on indigenous school education throughout history. Available at: [www.histedbr.fae.unicamp.br/acer.../Gabriela%20pontin%20novaes.pdf](http://www.histedbr.fae.unicamp.br/acer.../Gabriela%20pontin%20novaes.pdf). Accessed May 9, 2011.

OLIVEIRA, Anatalia Daiane de; ZIBETTI, Marli Lúcia Tonatto. What do Brazilian researches on indigenous school education reveal? Tellus, n. 29, p. 87-112, 2016. Available at: <http://www.tellus.ucdb.br/index.php/tellus/article/view/361/352>. Access on: 20 Aug. 2019

PAES, Maria Helena Rodrigues. On the border: the current dilemmas of the indigenous school in Paresi villages of Tangará da Serra-MT, in a view of Cultural Studies. Porto Alegre, 2002. 133f. Dissertation (Masters in Education) - Federal University of Rio Grande do Sul, Faculty of Education, Porto Alegre, 2002.

PAIXÃO, Antônio Jorge Paraense da. Interculturalism and politics in indigenous school education in Teko Haw village - Pará. 2010. 171f. Thesis (Doctorate in Education) - Pontificia Universidade Católica do Rio de Janeiro, Rio de Janeiro.

PALADINO, M. A mapping of affirmative actions aimed at indigenous peoples in higher education. In: BERGAMASCHI, M. A.; NABARRO, E.; BENITES, A. (Orgs.). Indigenous students in higher education: an approach based on the experience at UFRGS. Porto Alegre: UFRGS, 2013.

Constitutional principles. Principles of Isonomy. Available at: <http://principios-constitucionais.info/principio-da-isonomia.html>. Access on: 20 Aug. 2019.

ROMANOWSKI, Joana Paulin; ENS, Romilda Teodora. The so-called "state of the art" research in Education. Magazine Diálogo Educacional, Curitiba, v. 6, n. 19, p. 37-50, sep./dec., 2006. Available in: . Access on: 05 Aug. 2015.

ROSSATO, Veronice Lovato. The results of schooling among the Kaiowá and Guaraní in Mato Grosso do Sul - "Is the lyrics still one of ours? 2002, 185f. Dissertation (Masters in Education) - Dom Bosco Catholic University, Campo Grande, MS.

SANTOS FILHO, Roberto Lemos. Notes on indigenist law. Curitiba: Juruá. 2005, p. 45-49.

SECO, Ana Paula; AMARAL, Tania Conceição Iglesias do. Marquês de Pombal and the Brazilian educational reform. Navigating the history of Brazilian Education. HISTEDBR 20 YEARS. Available at: [http://www.histedbr.fe.unicamp.br/navegando/periodo\\_pombalino\\_intro.html#\\_ftn1](http://www.histedbr.fe.unicamp.br/navegando/periodo_pombalino_intro.html#_ftn1). Accessed on 24 Aug 2019.

MEANING OF MULTICULTURALISM. Available at: <https://www.significados.com.br/multiculturalismo/>. Access on: 20 Aug. 2019.

SORATTO, Marines. The construction of the school's direction for the indigenous high school students of the Francisco Horta Barbosa Reserve - Dourados/MS. 2007. 132f. Dissertation (Masters in Education) - Universidade Católica Dom Bosco, Campo Grande, MS

## **Torrefaction as a Pre-Treatment of Biomass: A Bibliometric Analysis**

**José Airton de Mattos Carneiro-Junior (Corresponding author)**

Biofuels Department, Federal Institute of Education, Science and Technology of Bahia, Irecê, State of Bahia, Brazil.

ORCID: <https://orcid.org/0000-0002-9599-7469>

Email: [airtonifba@gmail.com](mailto:airtonifba@gmail.com)

**Eduardo Oliveira Teles**

Informatic Department, Federal Institute of Education, Science and Technology of Bahia, 42.800-605, Camaçari, State of Bahia, Brazil.

ORCID: <https://orcid.org/0000-0003-4926-1423>

Email: [eoteles@gmail.com](mailto:eoteles@gmail.com)

**Fabio Matos Fernandes**

SMOS, Bahia State University, Salvador, State of Bahia, Brazil.

ORCID: <https://orcid.org/0000-0001-8679-120X>

Email: [fmatosf@gmail.com](mailto:fmatosf@gmail.com)

**Carine Tondo Alves**

Department of Energy Engineering, Federal University of the Reconcavo of Bahia, Feira de Santana, State of Bahia, Brazil.

ORCID: <https://orcid.org/0000-0001-8740-7011>

Email: [carine.alves@ufrb.edu.br](mailto:carine.alves@ufrb.edu.br)

**Silvio Alexandre Beisl Vieira de Melo**

Chemical Engineering Department, and Interdisciplinary Center on Energy and Environment, Federal University of Bahia, Salvador, State of Bahia, Brazil.

ORCID: <https://orcid.org/0000-0002-8617-3724>

Email: [sabvm@ufba.br](mailto:sabvm@ufba.br)

**Ednildo Andrade Torres**

Mechanical Engineering Department, and Interdisciplinary Center on Energy and Environment, Federal University of Bahia, Salvador, State of Bahia, Brazil.

ORCID: <https://orcid.org/0000-0002-0574-5306>

Email: [ednildotorres@gmail.com](mailto:ednildotorres@gmail.com)



## Abstract

*This article sought to investigate biomass torrefaction, analyzing the collaboration network between authors, institutions and countries in order to systematize the dynamics of scientific research on the subject. The systematic evaluation of the articles obtained in the scope of the research was important to provide an overview of the main stakeholders in the academic and institutional scope. This research is characterized as exploratory-descriptive of quantitative nature, whose technical procedure adopted was bibliometric research. A set of 662 documents were extracted from the main collection of Web of Science. The Vosviewer software was used to create scientific collaboration and co-citation networks. It was noted that the number of documents has been growing steadily since 2011, with a high degree of multidisciplinary collaboration and prolific contributions from American and Chinese researchers on this topic. The USA is the country with the largest number of publications (120 publications), followed by China (70 publications). There was a total of 1,894 authors and 594 institutions researching on biomass torrefaction, with SINTEF Energy Research – Norway having the largest number of publications, followed by National Cheng Kung University – Taiwan and Norwegian University of Science and Technology – Norway. The use of bibliometrics proposed here offers a systematic and dynamic approach to scientific research on biomass torrefaction. The identified groupings and collaboration networks presented a specific outline of the contents already published, authors, countries and institutions, in order to contribute as a starting point to future work in the field of biomass torrefaction.*

**Keywords:** bioenergy; thermoconversion; sustainability; research performance; academic networks.

## 1. Introduction

The global scenario of reducing the use of fossil energy and replacing it with renewable and more sustainable sources of energy has been the subject of studies and research in different areas around the world (DALLEMAND et al., 2015, WBA, 2019). And in this context, biomass is presented as an alternative capable of providing positive responses in energy generation and reduction of greenhouse gas emissions, by correcting some disadvantages of its direct application (NUNES and MATIAS, 2020).

The scope of sustainability in the production and commercialization of biomass on a large scale has been increasing strongly as part of a globalized world through *commodities* such as bioenergetics, for example, wood pellets, biodiesel and ethanol. With the participation of academia, research institutions and governments, the industry has been developing and commercializing significantly new technologies and fuels from biomass (IEA, 2019). Solid biomass from forest residues and products, for example, is being increasingly used as a source of commercial energy (DALLEMAND et al., 2015, WBA, 2019).

For industrial application of biomass as a solid fuel for burning or co-burning in the generation of heat and/or energy, it is necessary that characteristics intrinsic to biomass, such as high moisture content, low calorific value, hygroscopic nature and low density, are required improved (BERGMAN and KIEL, 2005, PROSKURINA et al., 2017).

For this, different biomass pretreatment technologies have been presented in the literature, such as drying, densification and torrefaction. The torrefaction technology, to be addressed in this work, consists of the

slow heating of the biomass, temperature range between 200 and 300 °C, in an inert environment, aiming at the modification of the physical and chemical composition of the biomass. The solid fuel obtained from torrefaction, called torrefied biomass, has an improved calorific value, hydrophobic, rot-resistant, and with prolonged storage time, when compared to crude biomass (ÁLVAREZ et al., 2018, CHEN et al., 2015, KANWAL et al., 2019).

Based on these characteristics and improvements in torrefied biomass, the commercial interest in using it as solid fuel has increased and are related to gasification, co-burning of biomass-coal, combined heat and power generation, autonomous combustion, fuel production and bio-based chemicals, heating blast furnaces, among other industrial applications (ARTEAGA-PÉREZ et al., 2017, LAU et al., 2018, PAHLA et al., 2018, YANG et al., 2019).

The torrefaction of the biomass can also be combined with densification processes (pelletizing or briquetting), improving the energy content of the biomass per unit mass (BATIDZIRAI et al., 2014, CHEN et al., 2015, SVANBERG and HALLDÓRSSON, 2013). Such improvements favor logistics and generate a positive economic impact at various points in the supply chain (CHEN et al., 2015, SVANBERG and HALLDÓRSSON, 2013).

Studies in the area of torrefaction have increased in recent years and a large number of literature reviews on biomass torrefaction have been published. Some of these reviews have a general scope across the field (BACH and SKREIBERG, 2016, RIBEIRO et al., 2018, SUKIRAN et al., 2017), while others focus on the supply chain (BATIDZIRAI et al., 2014, CIOLKOSZ and WALLACE, 2011, SVANBERG and HALLDÓRSSON, 2013), greenhouse gas emissions and life cycle assessment (MCNAMEE et al., 2016, UBANDO et al., 2019), torrefaction for co-burning biomass and/or new technological advances (ARTEAGA-PÉREZ et al., 2017, BERGMAN et al., 2005). Some studies deal with torrefaction modeling and kinetics (BATES and GHONIEM, 2013, PARK et al., 2015), torrefaction processes and products from different biomasses (ACHARYA and DUTTA, 2016, SUKIRAN et al., 2017), and the development of different types of protocols and scale of reactors used in torrefaction (BASU, 2018, BATIDZIRAI et al., 2013).

Each study presents information about a certain area of the research field, but there is a gap in additional analyzes using bibliometric tools, which can assist in *insights* that have not been fully addressed.

Thus, this work aimed to present the mapping of publications in the field of biomass torrefaction from bibliometric analysis, aiming to highlight the main collaboration networks between authors, institutions, and countries. To the best of our knowledge, no one has yet investigated the bibliometric analysis of biomass torrefaction as in the present study.

## 2. Conceptualization on Torrefaction

The torrefaction consists of the thermal treatment of biomass at temperatures between 200 and 300 °C, in an inert atmosphere, aiming at changing the chemical composition and energy value of the generated solid product. It is an endothermic process, which leads to the improvement of energy density, ignition, grinding, elevation of C/O and C/H ratio, hydrophobicity, homogeneity and reduction of toughness, fibrous structure, moisture and microbial activity of crude biomass (BERGMAN and KIEL, 2005, PRINS et al., 2006b). The

basic concept for torrefaction processes is commonly the same, although there are variations in the process for the different reactor concepts (Figure 1).

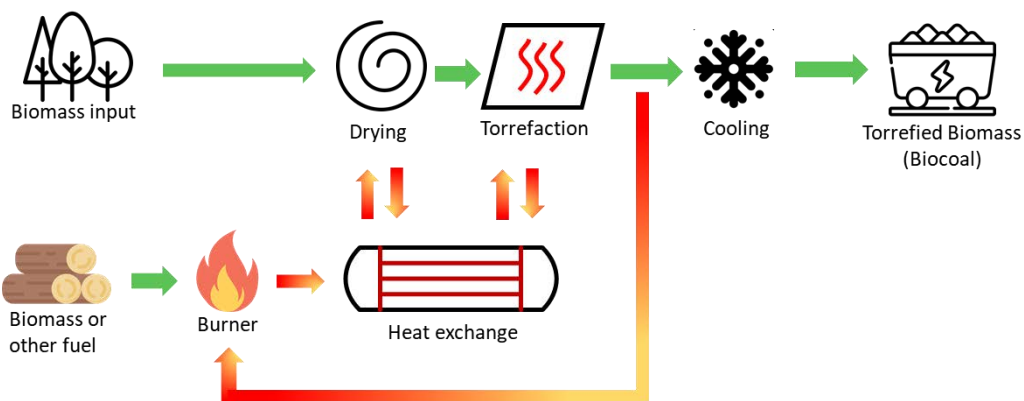


Figure 1: Overview of torrefaction process (adapted from Koppejan et al. (2012)).

Torrefied biomass has a lower moisture content, volatile material and calorific value when compared to its original raw biomass (ACHARYA and DUTTA, 2016, YANG et al., 2019), and the combustibility and burning performance of pretreated biomass is, therefore, higher than crude biomass. When compared to crude biomass, the energy density of torrefied biomass is closer to that of coal (PAHLA et al., 2018, YANG et al., 2019). Torrefied biomass is more suitable for use as a solid fuel, since its use as a raw material is capable of improving the performance of thermochemical processes, such as pyrolysis and gasification (PRINS et al., 2006a) and, in boilers and blast furnaces (BERGMAN et al., 2005, LAU et al., 2018).

The products obtained from conventional torrefaction include gases, liquid and solid, similar to pyrolysis, but solid fuel is the main product of torrefaction. The gaseous product normally contains 10% of the biomass energy and its low calorific value has few practical applications (VAN DER STELT et al., 2011, WANNAPEERA et al., 2011). The main non-condensable products mainly comprise CO, CO<sub>2</sub>, H<sub>2</sub> and fractions of CH<sub>4</sub>, toluene, benzene and low molecular weight hydrocarbons are also detected (ÁLVAREZ et al., 2018, PRINS et al., 2006b). The liquid product varies from brown to black, depending on the torrefaction temperature, and consists of condensable components such as water, acetic acids, alcohols, aldehydes and ketones (CHEN et al., 2015, CHEW and DOSHI, 2011).

Torrefaction is characterized by different process parameters, which include temperature, reaction time, type of biomass and particle size. Temperature and reaction time are the main parameters in the implementation of this pre-treatment of crude biomass. Based on temperature, conventional biomass torrefaction processes can be classified as light, mild and severe torrefaction, where temperatures are in the range of approximately 200-235, 235-275 and 275-300 °C, respectively (MEDIC et al., 2012, WANNAPEERA et al., 2011).

As for the torrefaction time, the longer the reaction time, the greater the energy density of the solid fuel resulting from the increase in the carbon content in the torrefied biomass (MEDIC et al., 2012, ROUSSET et al., 2011). In this case, the longer reaction time results in the higher energy expenditure of the torrefaction. Thus, the torrefaction temperature parameter has a greater influence on the change in biomass properties than the reaction time (KANWAL et al., 2019).

The size of the biomass particles influences the reaction mechanism, the kinetics and the duration of the process for a specified heating rate (MAMVURA and DANHA, 2020). The type of biomass is another important parameter of influence on torrefaction, considering that hemicellulose is the component that most decomposes in the torrefaction temperature range. It is observed that, for a biomass with a high hemicellulose content, a high loss of mass is expected during the torrefaction process.

In addition to conventional or non-oxidative torrefaction, biomass torrefaction can also be carried out in other environments, such as gases containing oxygen, high pressure water or steam, impregnated with ionic liquids, among other environments. In general, there are different torrefaction processes based on the reaction medium, such as: Dry torrefaction (BASU, 2018, BERGMAN and KIEL, 2005, MEDIC et al., 2012), Wet torrefaction (BACH and SKREIBERG, 2016, HOEKMAN et al., 2011), and torrefaction with Ionic Liquids (CAO et al., 2009, SARVARAMINI et al., 2013, ZHANG et al., 2017). Dry torrefaction is carried out at temperatures varying between 200-300 °C, in an inert environment and ambient pressure (CHEN et al., 2015, CHEW and DOSHI, 2011, CIOLKOSZ and WALLACE, 2011), as previously presented. Wet torrefaction or hydrothermal carbonization (HTC) occurs in a hydrothermal atmosphere in the temperature range between 180-260 °C and higher pressure than water vapor (ARTEAGA-PÉREZ et al., 2017, HOEKMAN et al., 2011). The use of ionic liquids at room temperature (RITLs) in the torrefaction process can be useful due to its chemical and thermal stability, non-flammable and low vapor pressure, being an alternative to conventional volatile organic solvents (CAO et al., 2009, SARVARAMINI et al., 2013).

The reactors generally used in torrefaction are identified according to Dhungana et al. (2012) as: laboratory, pilot or commercial scale. Among the main types of laboratory reactors, there are: (i) fixed bed torrefaction reactor, (ii) microwave torrefaction reactor, (iii) rotary drum reactor and (iv) fluidized torrefaction reactor. Regarding the commercial torrefaction technologies available on the market, characterized by their reactor designs, they can be grouped based on the mixing pattern criteria and based on the heat exchange mechanism (BATIDZIRAI et al., 2013, DHUNGANA et al., 2012). In this context, dry torrefaction is the technology most commonly applied on a commercial scale (RIBEIRO et al., 2018) since most current torrefaction technologies are based on concepts of existing reactors intended for other purposes, such as drying or pyrolysis (KIEL, 2011), requiring only improvements in technical protocols for torrefaction applications.

It is verified that the torrefaction is in constant technological development, at different levels of innovation, both in academia and in the industry, seeking to improve operational performance, standardization and quality of the final product. The diversity of interrelated areas shows a wide field for the development of new research and the application of protocols at other scales.

### **3. Bibliometric Method**

This research is characterized as exploratory-descriptive of quantitative being, whose technical procedure adopted was bibliometric research. As defined by Pritchard (1969), bibliometric study can be defined as “the application of mathematical and statistical methods to books and other communication media”. Bibliometric analyzes result in indicators of research quantity and performance, and can also provide

measurements of the connections between researchers and research areas through the analysis of networks, collaborations and citations (REHN et al., 2014).

The analysis of collaboration networks using bibliometric tools can further enhance the identification of the influence of already established or emerging areas, and can also assist in the identification of research groups, researchers and institutions, showing how the various areas of knowledge may have emerged from the characteristics of the identified authors and institutions (FAHIMNIA et al., 2015).

For the analysis of the information and the generation of results, Figure 2 shows the stages of the bibliometric study of publications related to biomass torrefaction.

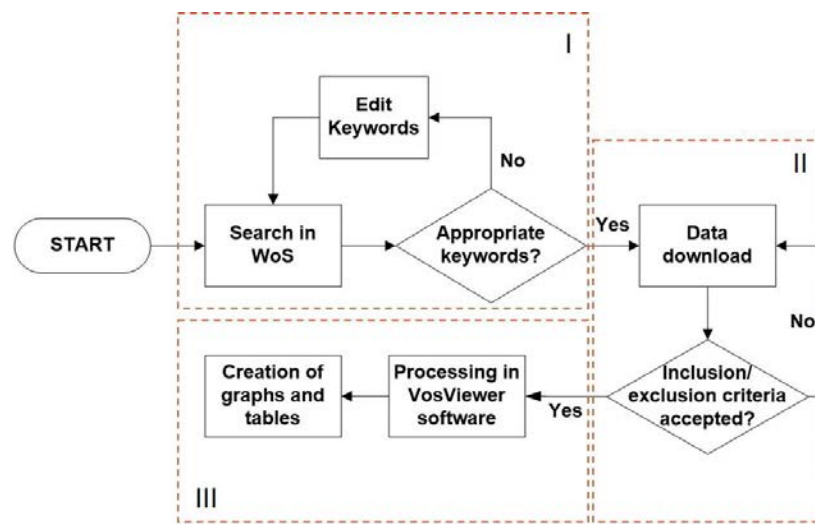


Figure 2: Procedure for bibliometric analysis (adapted from Ochoa et al. (2019)).

In the first step, the search for the subject determined by the keywords that facilitate and cover the largest amount of information to be analyzed is defined. The keywords have been properly assessed during the biomass torrefaction technology aimed at improving the energy raw materials, as the topic torrefaction is several times also used as process grain toast (roasting).

The terms used in the research emphasized the fields of “biomass”, “torrefaction”, and “densification”, based on variations of the terms and combined using Boolean operators, applied to the time interval from 2000 to 2019, with information obtained on 01/11/2020. The expressions and/or keyword terms should appear in the title. The following search expression was used:

**TI = ((torrefaction OR torrefied OR torrefying) AND (biomass OR lignocellulosic OR wood OR "agri-wastes" OR "agricultural wastes" OR "agricultural residues" OR "forest residues" OR "forest waste "OR biocoal OR briquet \* OR pellet \*))**

The research database was Clarivate Analytics' Web of Science Core Collection (WoS), for the metric and relevance of studies available from the keywords used. WoS has wide coverage of the main journals available in the world, published in indexed journals and classified according to the impact factor of the Journal Citation Reports (JCR).

In the second step, based on the general procedure for obtaining research reports and data sets from the WoS database, the articles were coded according to: year of publication, place of publication, authorship and co-authorship, keywords, periodicals/journals and publication language.



It was considered that each article should have up to 10 authors or organizations or countries, and at least 05 documents in the database. In addition to the initial data processing using Excel spreadsheets (Microsoft Office), the VOS Viewer software was chosen due to its ability to work with large data sets and to develop a range of analysis options and innovative investigations, creating intuitive images that assist in data analysis (FAHIMNIA et al., 2015).

In the third stage, filters were established using inclusion/exclusion criteria for publications that met the biomass torrefaction field. The following criteria were formulated:

- a) Was the publication reported in a peer-reviewed journal article?
- b) Did the publication investigate or address the development of torrefaction technology?
- c) Did the publication report research methods and provide scientific evidence about biomass torrefaction and biomass energy improvement?
- d) Does the publication have the complete record in the database and available bibliographic references?

The development and scientific analysis were based on the co-authorship of the documents published in journals, especially in journals, aiming to identify the main clusters of the research field and focal points of the collaboration networks. Finally, graphs and tables were elaborated for the discussion presented in this article.

Thus, we sought to identify and filter the scope of the database to be analyzed, in order to ensure that the information can be interpreted reliably and that the study is correctly classified, as proposed by Kitchenham (2004). The results of the analysis and data synthesis will be presented in the following subsections, highlighting the main collaboration networks of authors, institutions and countries, as well as profiles of trends in research and development of biomass torrefaction over the applied time interval.

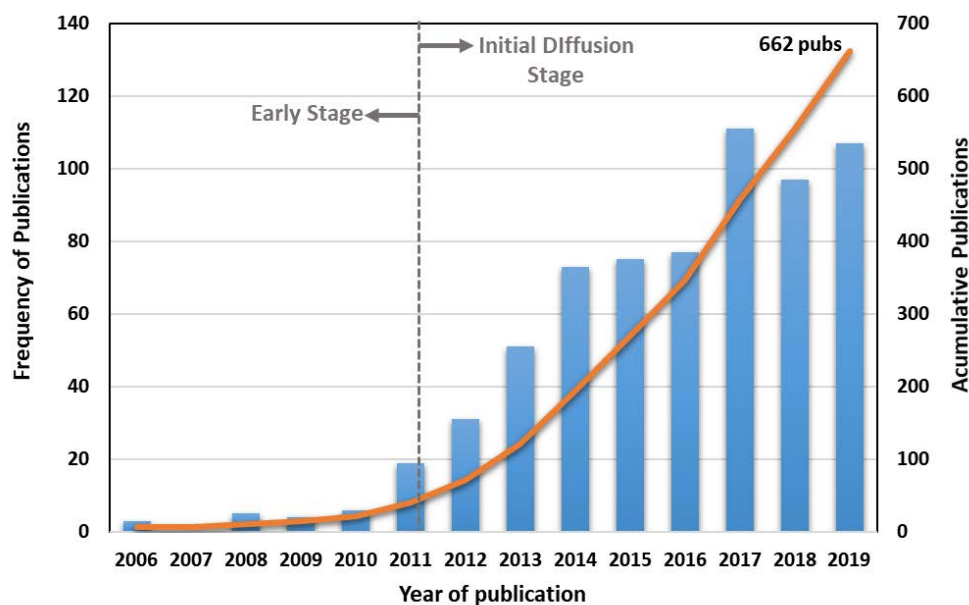
## **4. Bibliometric Analysis of Networks**

### **4.1 Characteristics of Publications**

662 publications were obtained that met the objectives defined in this study from the main collection of WoS, published in the period from 2000 to 2019. Among the different types of publications, most were from Articles (73.3 %), Proceeding Paper (17.4 %) and Reviews (3.6 %). The predominant languages of the publications were English (98.2 %), followed by German (0.45 %), Polish (0.45 %) and Korean (0.3 %).

Figure 3 shows the evolution of research in the field of biomass torrefaction over time. The frequency of publications over the analyzed period has been quite regular in the number of publications over the years. As of 2011, there is a presence of linear growth in the number of publications (p-value: <0.004) and a strong relationship strength ( $R^2$ : 0.953), based on the regression test performed.





**Figure 3.** The annual number of periodical articles during 2006–2019.

No documents were identified in the WoS 2000, 2001, 2005 and 2007 databases, referring to the search field for the keywords used for biomass torrefaction. Similarly observed by Perea-Moreno et al. (2019), identified that there was no significant growth in the scientific production of biomass as a renewable source, in the period 1978-2006.

From 2006 to 2010, the rate of scientific publications fluctuated at low values (3 to 10 publications). From 2011 onwards, it can be seen that the number of scientific publications increased significantly (up to 61.9%) concerning previous years. In the period from 2012 to 2016, the number of publications was more intensified and progressive, followed by the period of 2017-2019 with even higher values, respectively, 111, 97 and 107 publications per year. Thus, research in this field has been in constant development over the past 10 years and can be characterized by the beginning of the diffusion and maturation of technology. Table 1 shows the main journals that published in the torrefaction field obtained in the WoS database between 2000 and 2019.

**Table 1.** The most productive journals during 2000-2019.

Journals	Total Volumes <sup>a</sup>	Total Citation <sup>b</sup>	Impact Factor (JCR) <sup>c</sup>	Energy & Fuels Category
Energy & Fuels	56 (1°)	1451 (7°)	3,421 (Q2)	55°
Bioresource Technology	51 (2°)	2811 (1°)	7,539 (Q1)	13°
Fuel	49 (3°)	1710 (6°)	5,578 (Q1)	24°
Energy	37 (4°)	2565 (2°)	6,082 (Q1)	20°
Biomass & Bioenergy	35 (5°)	1813 (5°)	3,551 (Q2)	53°
Applied Energy	31 (6°)	1853 (4°)	8,848 (Q1)	9°
Journal of Analytical and Applied Pyrolysis	23 (7°)	1916 (3°)	3,905 (Q2)	41°

Fuel Processing Technology	16 ( 8°)	887 (9°)	4,982 (Q2)	29°
Bioresources	16 (9°)	116 (15°)	1,409 (Q1)	-
Energies	11 (10°)	119 (14°)	2,702 (Q3)	63°
Energy Conversion and Management	11 (11°)	485 (10°)	8,208 (Q1)	11°

<sup>a</sup>Total Volumes: Total number of volumes and the ranking of the total of number of volumes; <sup>b</sup>Total Citation: Total number of citations and the ranking of the total of number of citations; <sup>c</sup>2019 Journal Impact Factor and quartile in the category Energy & Fuels; <sup>d</sup>Title discontinued as of 2019.

About 51 % of the articles related to biomass torrefaction, in the period 2000-2019, were published in the main journals listed. These results show a trend of publication in specialized high impact journals that range from the chemical conversion of raw materials, design and operation of plants and equipment, as well as the development, production, use, application, conversion and management of non-renewable fuels (such as wood, coal, oil and gas) and renewable energy sources (solar, wind, biomass, geothermal, hydroelectric). It is important to note that journals that publish more articles are more likely to be cited, which may cause a tendency to increase the number of citations. Gargouri et al. (2010) defend in this respect empirical results in favor of the positive causal relationship between open access and the number of citations.

This information aims to assist in the prospecting of the database and in the development of high impact research in the field of biomass torrefaction, in addition to contributing to the choice of the journals to be published.

Table 2 presents the 10 most cited articles in the period from 2000 to 2019 related to biomass torrefaction, this shows that the content present in these documents has been essential for the development of different research areas.

**Table 2.** The 10 most citations articles during 2000-2019.

Articles	Reference	Total Citation	Year
Biomass upgrading by torrefaction for the production of biofuels: A review	Van der Stelt, M.J.C.; Gerhauser, H.; Kiel, J.H.A.; Ptasinski, K.J.	719 (1°)	2011
Impact of torrefaction on the grindability and fuel characteristics of forest biomass	Phanphanich, M.; Mani, S.	477 (2°)	2011
Influence of torrefaction on the grindability and reactivity of woody biomass	Arias, B.; Pevida, C.; Fermoso, J.; Plaza, M.G.; Rubiera, F.; Pis, J.J.	470 (3°)	2008
A state-of-the-art review of biomass torrefaction, densification and applications	Chen, W.H.; Peng, J.H.; Bi, X.T.T.	446 (4°)	2015
More efficient biomass gasification via torrefaction	Prins, M.J.; Ptasinski, K.J.; Janssen, F.J.J.G.	393 (5°)	2006
Torrefaction of wood - Part 2. Analysis of products	Prins, M.J.; Ptasinski, K.J.; Janssen, F.J.J.G.	373 (6°)	2006

Torrefaction of wood - Part 1. Weight loss kinetics	Prins, M.J.; Ptasinski, K.J.; Janssen, F.J.J.G.	360 (7°)	2006
Pre-treatment technologies, and their effect on international bioenergy supply chain logistics. Techno-economic evaluation of torrefaction, fast pyrolysis and pelletization	Uslu, A.; Faaij, A.P.C.; Bergman, P.C.A.	355 (8°)	2008
A study on torrefaction of various biomass materials and its impact on lignocellulosic structure simulated by a thermogravimetry	Chen, W.H.; Kuo, P.C.	309 (9°)	2010
Recent advances in biomass pretreatment - Torrefaction fundamentals and technology	Chew, J.J.; Doshi, V.	301 (10°)	2011

The most cited article (719 citations) on the WoS platform in this field was the “*Biomass upgrading by torrefaction for the production of biofuels: A review*”, published in 2011 in the journal Biomass & Bioenergy, by Van der Stelt et al. (2011). In this review article the general characteristics of the torrefaction are presented, a brief history of the torrefaction, the overview of different mass and energy balances, the applications and the economic potential of the torrefaction.

As we can see, the top 10 most cited articles in the field of biomass torrefaction were published between 2006 and 2011, except for the article “*A state-of-the-art review of biomass torrefaction, densification and applications*” dated 2015. It is commonly agreed in the literature that pre-treatment by torrefaction improves different characteristics of the fuel, making it more suitable for both domestic and industrial applications. Although these documents support the scientific basis in the field of torrefaction, it is important to state that they do not guide current and future trends. This subject will be better addressed in the following sections of this work.

#### 4.2 Countries and Institutions Contributions Analysis

Publications can be presented according to the contribution of different countries, territories and institutions through the analysis of postal addresses of publications. The ranking of the top 10 countries regarding the number of scientific publications in the field of biomass torrefaction is shown in Table 3.

**Table 3.** International collaboration of top countries.

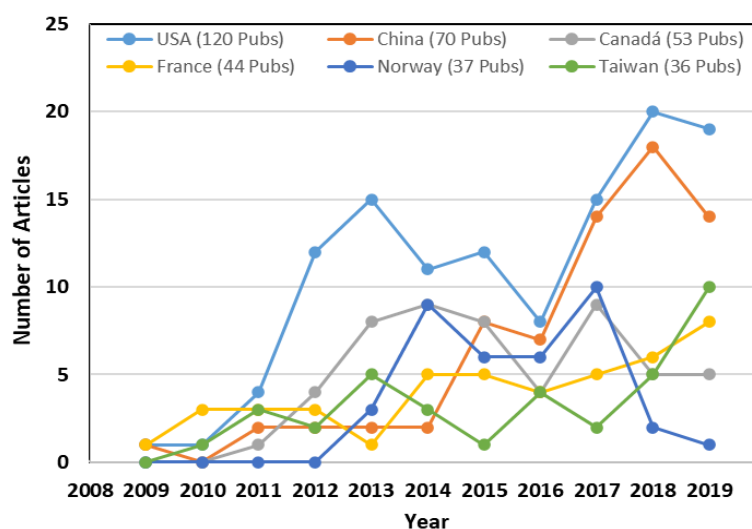
Country	TP	TPR	TC	TCR	TS	TSR
USA	120	1 (14.5)	3865	1 (15.8)	53	1 (11.7)
China	70	2 (8.5)	2395	4 (9.8)	45	2 (9.9)
Canada	53	3 (6.4)	1921	5 (7.9)	36	3 (7.9)
France	44	4 (5.3)	1496	6 (6.1)	28	5 (6.2)
Norway	37	5 (4.5)	948	7 (3.9)	29	4 (6.4)
Taiwan	36	6 (4.3)	2587	3 (10.6)	24	6 (5.3)
South Korea	35	7 (4.2)	473	17 (1.9)	16	10 (3.5)
Netherlands	34	8 (4.1)	2722	2 (11.1)	15	12 (3.3)

Brazil	30	9 (3.6)	562	13 (2.3)	16	11 ( 3.5)
Malaysia	29	10 (3.5)	627	11 (2.6)	11	14 (2.4)

TP: Total number of articles; TPR (%): The ranking and percentage of the total number of articles; TC: Total number of citations; TCR (%): The ranking and percentage of the total number of citations; TS: Total link strength; TSR (%): The ranking and percentage of the total link strength.

The USA is the country with the largest number of publications (120), followed by China (70), Canada (53), France (44), Norway (37), Taiwan (36), South Korea (35), Germany (34), Brazil (30) and Malaysia (29). Considering the countries with at least 5 publications on the topic, there is a strong concentration of scientific production, so that only 10 countries produce around 59 % of the total publications. It is important to report that although Taiwan and Germany are respectively in 6th and 7th place in the ranking of publications, they are highly cited passing the placing of 3rd and 2nd place in countries most cited in the field of torrefaction.

In this context, a temporal analysis of the behavior of scientific production in the countries with the largest number of publications in the field of biomass torrefaction is opportune. Figure 3 shows the evolution of the number of publications in the 6 countries with the highest scientific production.

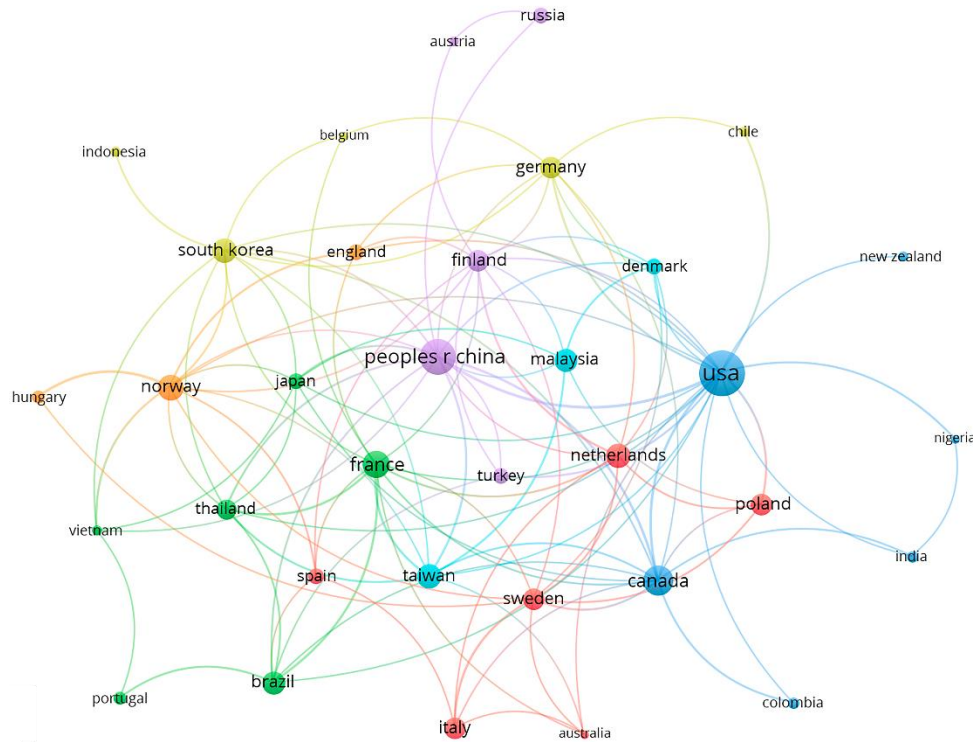


**Figure 3.** Annual growth curve of the top six countries.

It is possible to observe the significant increase in scientific production in the USA, followed by China over the last 10 years in the field of torrefaction. In general, the main countries showed greater stability in the growth of publications from the year 2015, except for Norway for the years 2018 and 2019.

This fact is taken into account due to the set of goals and actions observed worldwide aiming to mitigate climate change in the last 5 years, thus causing an intense search for energy alternatives to the use of fossil fuels. In a way, biomass has a strong potential in contributing to the reduction of greenhouse gas emissions. And torrefaction technology as an alternative capable of transforming biomass residues into solid fuels (NUNES and MATIAS, 2020) and directly replacing coal in generating electricity, especially those from energy forests. It turns out that the growth in the number of publications with different co-authors and areas of concentration has drawn attention in the development of torrefaction.

According to Giuliani (2005), identifying how knowledge transfer flows in collaboration networks or clusters is crucial for understanding how innovation happens. Figure 4 presents seven well-defined clusters of the collaboration network between countries, elaborated in the VOSviewer software from the WoS database, using the list of at least 5 documents published by country.



**Figure 4.** The cooperation network of the countries.

The origin of the publications made in the period from 2000 to 2019 was from 59 countries, however, when considering at least 5 publications per country, a collaboration network of 34 countries in 7 clusters was obtained. The clusters in Figure 4 are identified as:

- i. *Blue cluster*, whose countries are the USA, Canada, Colombia, India, New Zealand and Nigeria. It is the cluster with the highest percentage of publications (24.3 %).
- ii. *Violet cluster*, mostly Asian countries, including: China, Russia, Turkey, Austria and Finland. It is the second largest cluster in publications (16.2 %) along with the red cluster.
- iii. *Red cluster*, representing about 16.2 % of publications, has the leading position in publications in the Netherlands, mainly composed of the following European countries: Australia, Italy, Holland, Poland, Spain and Sweden.
- iv. *Green cluster*, with about 15.7 %, is associated with countries from different geographic regions, with greater representation of France in publications, with members in Brazil, Japan, Portugal, Thailand and Vietnam.
- v. *Light blue clusters*, composed of the countries: Denmark, Malaysia and Taiwan. This cluster represents about 9.8 % of the publications on biomass torrefaction.
- vi. *Yellow cluster*, with about 9.4 % of the total publications, South Korea and Germany lead, followed by Chile, Indonesia and Belgium.

vii. *Orange cluster*, representing the least representative cluster in publications, with about 7.7 % of the publications related to biomass torrefaction, are the countries England, Hungary and Norway.

The USA and China countries present greater intensity in publications and centrality in the cooperation network, being in different clusters (blue and violet, respectively). It appears that the country networks are placed in such a way that the distance between them indicates, approximately, their relationship according to the aggregation criteria used by the VOSViewer software (VAN ECK and WALTMAN, 2010), thus conforming to the map of Figure 4. This construction and analysis of the network of countries has the emphasis on analyzing and visualizing large sets of bibliographic data from the distance-based approach. As noted in Table 2 and Figure 3, countries such as USA and China have a greater volume of publications and intensity in the collaboration network in the field of biomass torrefaction. There is still, despite being in different clusters, a strong research relationship due to the thickness of the connection line as shown in Figure 4.

With the increase in the growing energy demand, different public and private institutions have directed their research on solid fuels to the emphasis on energy improvement, reduction of greenhouse gases and optimization of production processes. Table 4 shows the main institutions that have published the most in the field of biomass torrefaction. About 594 institutions researching torrefaction were verified, making it necessary to use the filter of having published at least 05 co-authorship documents. Thus, 60 institutions were developed that developed publications in the field of torrefaction.

**Table 4.** The performance of the most productive organizations.

Organization	TP	TPR	TC	TCR	TS	TSR
SINTEF Energy Research, Norway	30	1 (4.5)	799	6 (4.0)	39	1 (10.6)
National Cheng Kung University, Taiwan	28	2 (4.2)	1884	1 (9.4)	28	3 (7.6)
Norwegian University of Science and Technology, Norway	26	3 (3.9)	620	9 (3.1)	36	2 (9.8)
University of British Columbia, Canada	17	4 (2.6)	1158	4 (5.8)	21	5 (5.7)
Agricultural Research for Development - Cirad, France	14	5 (2.1)	679	7 (3.4)	11	8 (3.0)
Technical University of Denmark, Denmark	14	5 (2.1)	523	13 (2.6)	9	11 (2.4)
Umea University, Sweden	13	7 (2.0)	460	14 (2.3)	11	9 (3.0)
Zhejiang University, China	11	8 (1.7)	676	8 (3.4)	6	19 (1.6)



Åbo Akademi University, Finland	10	9 (1.5)	276	24 (4.3)	6	20 (1.6)
Energy Research Centre of the Netherlands – ECN, Netherlands	10	9 (1.5)	868	5 (1.4)	4	27 (1.1)
Hungarian Academy of Sciences, Hungary	10	9 (1.5)	173	33 (1.1)	23	4 (6.3)
Swedish University of Agricultural Sciences, Swedish	10	9 (1.5)	229	27 (0.9)	9	12 (2.4)
Federal University of Viçosa, Brazil	10	9 (1.5)	71	49 (0.4)	0	46 (0.0)

TPR(%): The ranking and percentage of the total number of articles; TCR(%): The ranking and percentage of the total number of citations; TSR(%): The ranking and percentage of the total link strength.

SINTEF Energy Research - Norway leads with the largest number of publications (30 publications), followed by National Cheng Kung University - Taiwan (28 publications) and Norwegian University of Science and Technology - Norway (26 publications). The position of National Cheng Kung University and the University of British Columbia stands out for the high number of citations to their work. This may be related to the quality and innovation of your publications. Similarly, Eindhoven University of Technology - Netherlands (5 publications) and National University of Tainan - Taiwan (8 publications) draw attention to the number of citations concerning the number of publications, 1845 and 1321, respectively. It is important to note that SINTEF is one of the largest independent research organizations in Europe, having as a strong characteristic of the multidisciplinary and collaboration between various research groups throughout the organization.

In order to make a temporal cut of the four main institutions, Figure 5 shows the annual variation in the number of publications in the period from 2012 to 2019.

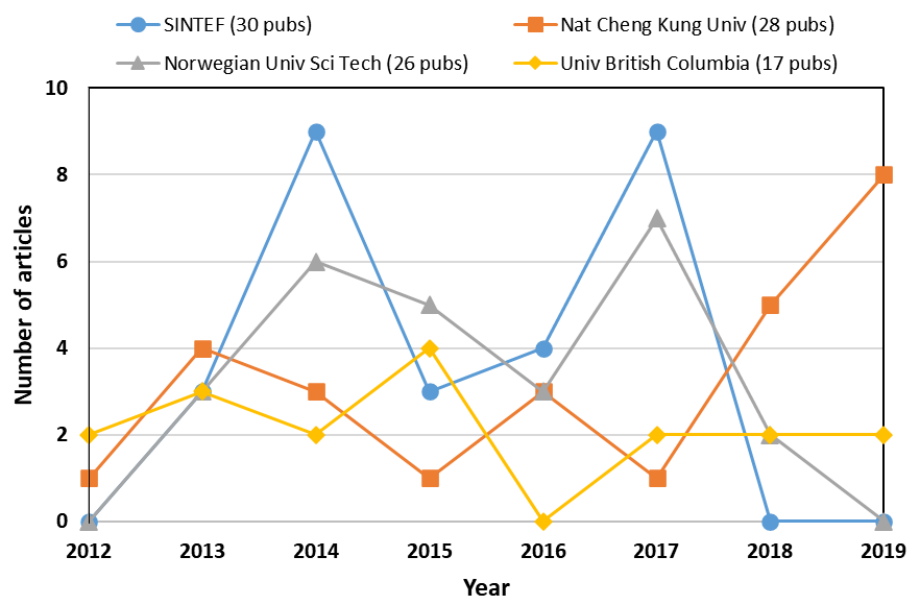
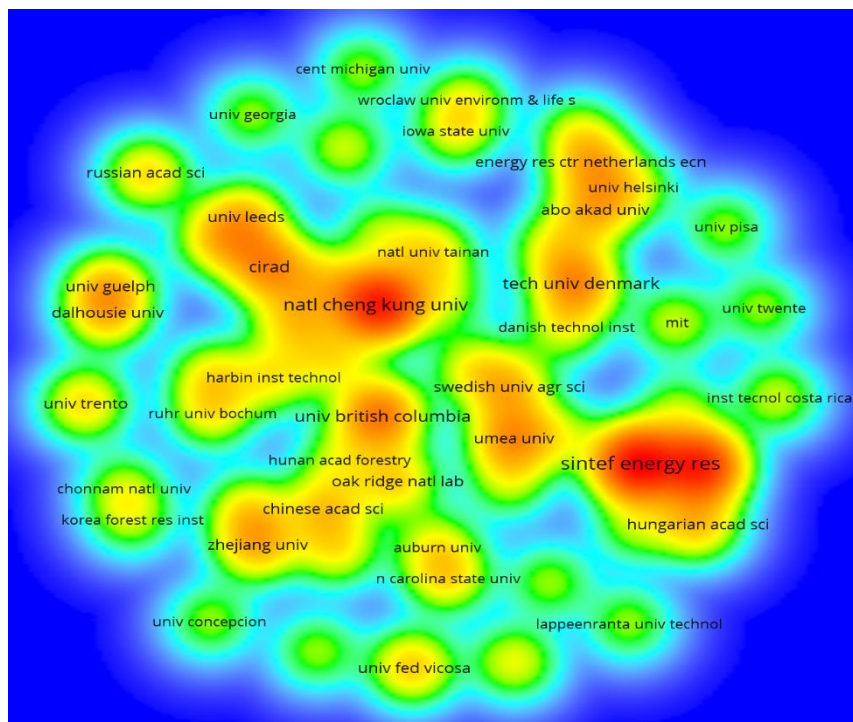


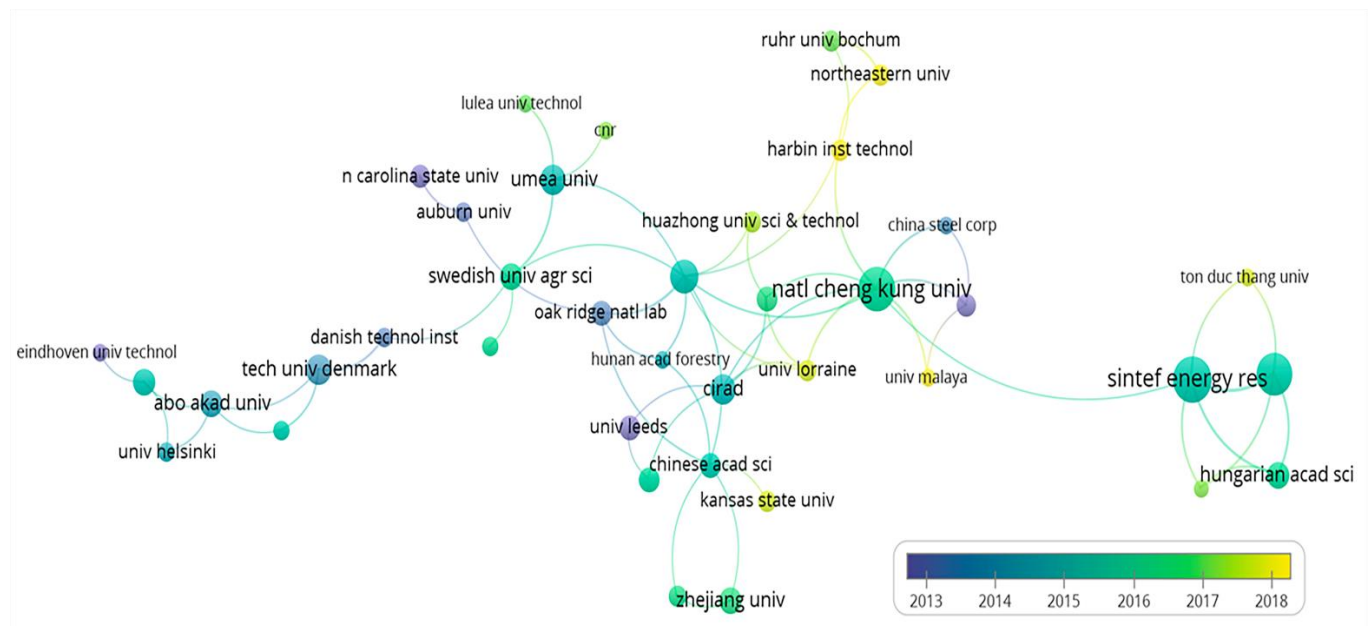
Figure 5. Annual growth curve of the main institutions.

Although the United States and China have the largest volume of publications, American and Chinese institutions did not appear individually at the top of the list. Caused by the difference in metrics between the authors and institutions where they develop the research. The four institutions that published the most varied considerably in the annual number of publications over the analyzed period. Among the institutions analyzed, National Cheng Kung University has presented an increasing number of publications in recent years (2017-2019). In contrast, SINTEF showed discontinuity in publications in 2018 and 2019 in the biomass torrefaction field, corroborating the fall in publications from Norway.

Figure 6 shows the general cooperation network of the institutions that have published in the field of biomass torrefaction, as also seen in Table 2. While Figure 7, the organizations with the greatest strength of the co-authorship link were selected to compose the network interinstitutional interconnection.



**Figure 6.** Density visualization of the institution's cooperation network.



**Figure 7.** The cooperation network of interconnected institution.

The connection between the different institutions is related to different forms of scientific cooperation between them, be it projects, articles, exchange, among others. The higher the point/marker in Figure 7 is of greater importance for the institution in this network, while the thicker and more intense the line, the narrower/more intense the cooperative relationship.

National Cheng Kung University, SINTEF Energy Research, The University of British Columbia and Norwegian University of Science and Technology are located in a highly relevant position in the field of torrefaction. Scientific cooperation between SINTEF, National Cheng Kung University and the University of British Columbia and Norwegian University of Science and Technology are also very strong and important in the development and dissemination of knowledge to other institutions in the collaboration network.

Also, it is possible to identify the pioneer institutions from the most intense color (dark blue) and see how much the field “biomass torrefaction” has gained interest in the growing number of institutions between the years 2016-2018, through the change in the intensity of colors (from green to yellow).

Between 2013 and 2019, there was an increase in the intensity of cooperation in publications, as also seen in Figure 5. It turns out that, of the total of 26 clusters generated from the database with 60 institutions, only 16 clusters were interconnected forming the component giant of the institutional collaboration network. This shows that part of the scientific activities has been carried out individually in institutional form, in most publications, indicating a wide field of inter-institutional collaborations to be developed.

#### **4.3 Detection of Scientific Communities**

The possibility of identifying the most influential researchers within the clusters helps to direct a possible determination of additional emerging fields of study by capturing more recent topics proposed by these researchers (FAHIMNIA et al., 2015). According to Perea-Moreno et al. (2019) a scientific community can be defined as a set of nodes that are more densely connected with each other than with the rest of the

network. In this sense, scientific communities tend to have a central nucleus cohesive with the peripheral spheres, which are the weakest links as they move away from the nucleus.

A total number of 1,894 authors will publish in the torrefaction field, according to the WoS database. In order to avoid disambiguation of the authors' names, the data were checked and corrected individually in relation to possible combinations of names represented by initials, name variations or duplication of authorship. Considering the occurrence of at least 5 publications indexed by the author, we obtain the number of 58 authors directly related to the biomass torrefaction field. Table 5 presents general information about the 10 authors who most published in indexed journals.

**Table 5.** The performance of the top 10 most productive authors.

<b>Author</b>	<b>Total Pubs</b>	<b>Total Citation</b>	<b>Total Strength</b>	<b>h-index<sup>a</sup></b>	<b>Country<sup>b</sup></b>
Wei-Hsin Chen	29	2540 (1°)	29 (4°)	27	Taiwan
Oyvind Skreiberg	27	636 (5°)	47 (1°)	14	Norway
Quang-Vu Bach	20	581 (7°)	30 (3°)	15	Norway
Khanh-Quang Tran	20	460 (8°)	35 (2°)	16	Norway
Animesh Dutta	10	360 (10°)	5 (42°)	10	Canada
Prabir Basu	8	161 (27°)	8 (31°)	9	India
Maurizio Grigante	8	47 (46°)	14 (8°)	7	Italy
Jun Li	8	285 (15°)	11 (18°)	12	Scotland
C. Jim Lim	8	323 (13°)	9 (28°)	14	Canada
Liang Wang	8	112 (35°)	13 (11°)	19	Norway

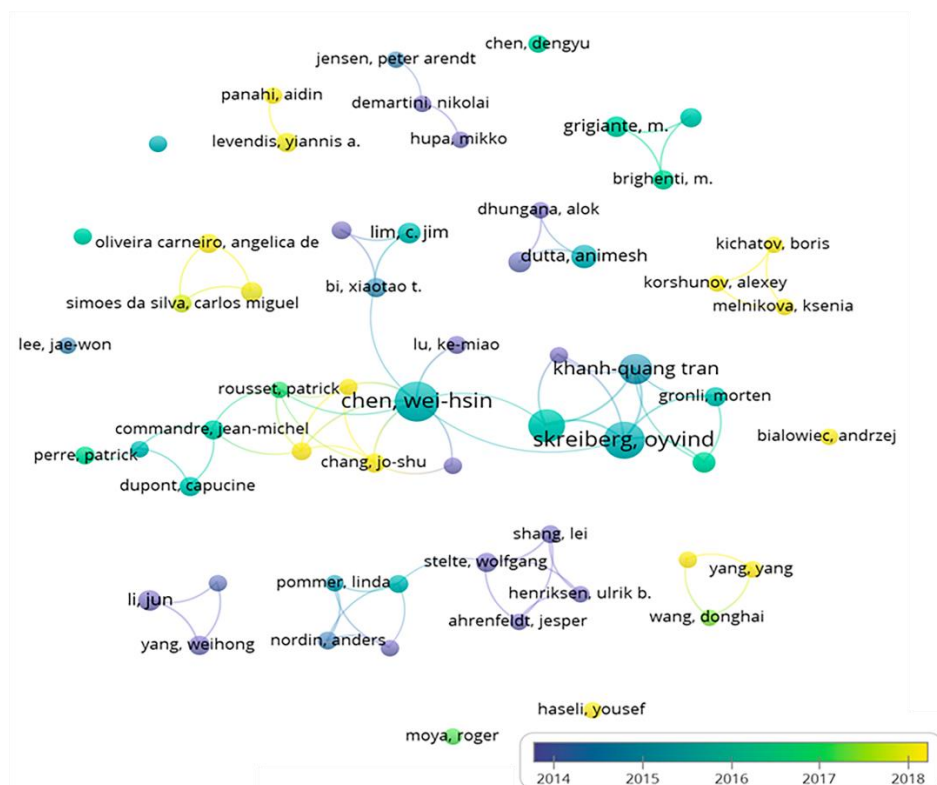
<sup>a</sup>Obtained from publications referring to the torrefaction of biomass and energy, in the period from 2000 to 2019, with information obtained on 01/11/2020. <sup>b</sup>Location of the author's research institution.

The authors that most stand out for the total number of publications are: Wei-Hsin Chen, from National Cheng Kung University - Taiwan, with 29 publications; Oyvind Skreiberg, from SINTEF Energy Research - Norway, with 27 publications; Quang-Vu Bach, from the Norwegian University of Science and Technology - Norway, with 20 publications; and Khanh-Quang Tran, from the Norwegian University of Science and Technology - Norway, with 20 articles.

The author Wei-Hsin Chen is the one that stands out both in the total number of publications (29 publications) and in the number of citations (2540 citations). Significant changes are also observed when analyzing the number of publications: citation. For example, authors Oyvind Skreiberg, Quang-Vu Bach and Khanh-Quang Tran were ranked 2nd, 3rd and 4th most publications, respectively; however, in the ranking of citations they were classified in 5th, 7th and 8th position, respectively. It may be related to the impact factor of publications or the means of dissemination. For this, the h-index is based on the assumption that the number of citations received by a scientist is a better indicator of the relevance of his work than the number of articles published or the journals in which they are published. According to Hirsch and

Buela-Casal (2014) the h-index takes into account the number of articles published and the citations to these articles in a balanced way and, therefore, is more indicated in comparisons between scientists.

The collaborative relationships between authors in the field of biomass torrefaction can be better understood from the understanding that scientific communities are generally groups that relate to members of groups from other communities (MONTROYA et al., 2018). Figure 8 shows the clusters (21 clusters) and collaboration networks between the main researchers (58 authors), with at least 5 publications, and the temporal overlap of authorship. It is observed the formation of different communities publishing about biomass torrefaction, corroborating with the previously discussed that the scientific activities in this field have been carried out, in most cases, in isolated or pulverized form.



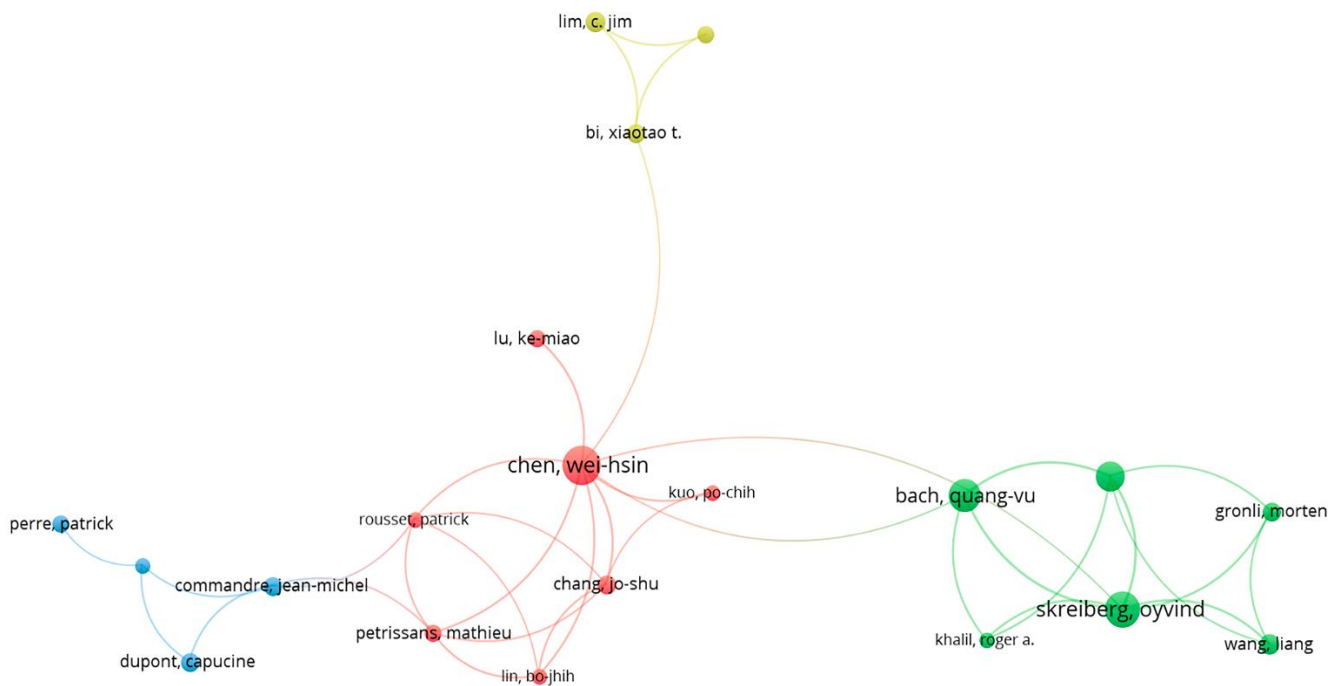
**Figure 8.** Network of authors in publications.

The existence of different groups of researchers was observed, with a large concentration of researchers in the central part of the network, a lower concentration in other regions and a set of isolated nodes disconnected from the rest of the network. The size of the nodes shows their relative frequency in the structure of the author network in Figure 8 and the width of the links illustrates the strength of the relationship between each pair. Besides, the network of authors highlights the existence of partially or totally isolated concentrations of researchers, with no connection to the centrality of the network. It appears that the average distance illustrates the level of maturity of the collaboration in the network by distance between the authors. In addition, a shorter distance means that there is a higher level of maturity in the collaboration network.

According to Fahimnia et al. (2015) the identification of the most influential researchers within the clusters helps to determine possible emerging fields of study by observing and cataloging the most recent topics



addressed by these researchers. Figure 9 shows the community with only interconnected authors and the details of the clusters of this scientific community are detailed in Table 6.



**Figure 9.** Interconnection network of authors in the biomass torrefaction publications.

**Table 6.** The author's communities in the topic biomass torrefaction.

Cluster	Color	Authors
1	Red	Chang, Jo-Shu; Chen, Wei-Hsin; Kuo, Po-Chih; Lin, Bo-Jhih; Lu, Ke-Miao; Petrissans, Mathieu; Rousset, Patrick
2	Green	Bach, Quang-Vu; Gronli, Morten; Khalil, Roger Antoine; Khanh-Quang, Tran; Skreiberg, Oyvind; Wang, Liang
3	Blue	Commandre, Jean-Michel; Dupont, Capucine; Perre, Patrick; Salvador, Sylvain
4	Yellow	Bi, Xiaotao T.; Lim, C. Jim; Sokhansanj, Shahab

The interconnected collaboration network (Figure 9) has 20 authors separated into 4 clusters, maintaining some level of interaction, sharing works and scientific development in the field of biomass torrefaction. The thicker the line, the greater the number and strength of this relationship. The green cluster has great centrality and strength in publications in the field of torrefaction due to the high individual performance of its main authors, forming its team and collaboration network. These researchers have strong research connections between them, which can be caused due to the geographical position and proximity of their research institutes.

In addition to what was observed in the collaboration and contribution networks of authors cataloged in WoS, in the scope of torrefaction technological development, recent advances have been gaining interest,



emphasizing the use of non-conventional raw materials, improvements in the production of torrefied pellets, new applications of torrefaction products and technological advances in production processes and torrefaction systems. As an example, publications on catalytic torrefaction (ONSREE and TIPPAYAWONG, 2020, TIPPAYAWONG et al., 2019), torrefaction-gasification integration processes (BACH et al., 2019, TAPASVI et al., 2015), use of binding agents (binders) to the torrefied biomass aiming to improve the pelletization process (BAI et al., 2016, EMADI et al., 2017), biomass torrefaction as an adsorbent (CIOLKOSZ et al., 2019, DODDAPANENI et al., 2018, GAN et al., 2018), a precursor in the production of liquid biofuels (CHALUVADI et al., 2019, SHEIKH et al., 2013), use of torrefaction biomass for soil correction/improvement (HAN et al., 2017, OGURA et al., 2016) and advanced applications of torrefaction condensate (DODDAPANENI et al., 2017, PAPADOPOULOU et al., 2018). There is also the development of research related to the hybridization of technologies, such as the use of solar energy and torrefaction (CELLATOĞLU and İLKAN, 2015, CHEN et al., 2020, SWAMINATHAN and NANDJEMBO, 2016)

## **5. Final Considerations and Conclusion**

Torrefaction as a pre-treatment technology for biomass was studied based on bibliometric co-authorship analysis and network analysis tools for a better systemic understanding of the research field. 662 publications were collected from the WoS database, mapped and highlighted the main collaboration networks between authors, institutions and countries. Although the database was collected from the WoS, which has a vast and comprehensive scientific collection, it is important to note that we do not have all the publications, with the possibility of significant bias in the research field, publication of reports and non-indexed documents, in addition to publications in other databases and languages. Not limited to that, complementary concepts about scientific collaboration networks and information on h-index, impact factor (JCR) and category of journals were presented.

The increase of publications on biomass torrefaction had a linear growth and with greater intensity from the year 2011, continuing to the present day. This growth trend is likely to continue in the coming years, as the international biomass market has been increasingly consolidated with the substitution of conventional coal for biocarbon, mainly in the form of pellets. The scientific community in this field of research has focused its efforts on improving processes and technologies for the production of these solid fuels.

In the period from 2000 to 2019, it was observed that the journals "Energy & Fuels", "Bioresource Technology", "Fuel", "Energy" and "Biomass & Bioenergy" were the ones that published the most about biomass torrefaction from the WoS database. The countries that are ahead in the volume of publications, based on the affiliation of co-authors, were: USA, China, Canada, France, Norway, Taiwan, South Korea and Holland. Consequently, the USA and China are at the center of the great collaboration network.

Institutional collaboration networks have been analyzed for their origin and development over the years. The institutions with the largest number of scientific publications were SINTEF and Norwegian University of Science and Technology, both Norwegian; National Cheng Kung University, Taiwanese; University of British Columbia, Canadian; Cirad, French; Technical University of Denmark, Danish and Umeå University, Swedish. Despite the existence of different groups of researchers, at the center of the scientific

community is the Taiwanese author Wei-Hsin Chen, followed by Norwegians Oyvind Skreiberg, Quang-Vu Bach, and Khanh-Quang Tran.

The methodological limitation of this study is in the restriction used as to the search strategy only in the "title", being justified by the large number of publications without being related to the study when the search for "topic" (title and/or abstract and/or keywords). The possible expansion of keyword combinations is another possible limiting factor, however with the increase in the number of combinations it can result in a more exhaustive review and without significant differences with the present study.

Institutional collaboration networks showed the direction for new insights and pointed out the origin of the technological development of torrefaction. Finally, the identification of the most influential researchers within the clusters aimed to assist in determining possible emerging fields of study by observing and cataloging the most recent topics addressed by these researchers.

## **Acknowledgements**

This work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel - Brazil (CAPES) - Financing Code 001.

## **References**

- B. Acharya and A. Dutta (2016). "Fuel property enhancement of lignocellulosic and nonlignocellulosic biomass through torrefaction". *Biomass Conversion and Biorefinery*, 6 (2), 139-149.
- A. Álvarez, D. Nogueiro, C. Pizarro, M. Matos and J.L. Bueno (2018). "Non-oxidative torrefaction of biomass to enhance its fuel properties". *Energy*, 158 1-8.
- L.E. Arteaga-Pérez, H. Grandón, M. Flores, C. Segura and S.S. Kelley (2017). "Steam torrefaction of Eucalyptus globulus for producing black pellets: A pilot-scale experience". *Bioresource technology*, 238 194-204.
- Q.-V. Bach, H.-R. Gye, D. Song and C.-J. Lee (2019). "High quality product gas from biomass steam gasification combined with torrefaction and carbon dioxide capture processes". *International Journal of Hydrogen Energy*, 44 (28), 14387-14394.
- Q.-V. Bach and Ø. Skreiberg (2016). "Upgrading biomass fuels via wet torrefaction: A review and comparison with dry torrefaction". *Renewable and Sustainable Energy Reviews*, 54 665-677.
- X. Bai, G. Wang, D. Wang, Z. Wang, C. He, H. Wu and W. Liu, "Co-pelletization of torrefied wheat straw and peanut shells: The energy consumption and properties of pellets".(2016). *American Society of Agricultural and Biological Engineers*, 1.
- P. Basu, "Torrefaction (Chapter 4)".(2018). Elsevier,
- R.B. Bates and A.F. Ghoniem (2013). "Biomass torrefaction: Modeling of reaction thermochemistry". *Bioresource technology*, 134 331-340.
- B. Batidzirai, A. Mignot, W. Schakel, H. Junginger and A. Faaij (2013). "Biomass torrefaction technology: Techno-economic status and future prospects". *Energy*, 62 196-214.

- B. Batidzirai, F. van der Hilst, H. Meerman, M.H. Junginger and A.P. Faaij (2014). "Optimization potential of biomass supply chains with torrefaction technology". *Biofuels, Bioproducts and Biorefining*, 8 (2), 253-282.
- P.C. Bergman, A. Boersma, R. Zwart and J. Kiel (2005). "Torrefaction for biomass co-firing in existing coal-fired power stations". Energy Research Centre of the Netherlands, ECN-C-05-013,
- P.C. Bergman and J.H. Kiel, "Torrefaction for biomass upgrading".(2005). 17-21.
- Y. Cao, J. Wu, J. Zhang, H. Li, Y. Zhang and J. He (2009). "Room temperature ionic liquids (RTILs): A new and versatile platform for cellulose processing and derivatization". *Chemical Engineering Journal*, 147 (1), 13-21.
- N. Cellatoğlu and M. İlkan (2015). "Torrefaction of solid olive mill residue". *BioResources*, 10 (3), 5876-5889.
- S. Chaluvadi, A. Ujjwal and R. Singh (2019). "Effect of Torrefaction Prior to Biomass Size Reduction on Ethanol Production". *Waste Biomass Valorization*, 10 (12), 3567-3577.
- D. Chen, K. Cen, X. Cao, J. Zhang, F. Chen and J. Zhou (2020). "Upgrading of bio-oil via solar pyrolysis of the biomass pretreated with aqueous phase bio-oil washing, solar drying, and solar torrefaction". *Bioresource Technology*, 123-130.
- W.-H. Chen, J. Peng and X.T. Bi (2015). "A state-of-the-art review of biomass torrefaction, densification and applications". *Renewable and Sustainable Energy Reviews*, 44 847-866.
- J.J. Chew and V. Doshi (2011). "Recent advances in biomass pretreatment–Torrefaction fundamentals and technology". *Renewable and sustainable energy reviews*, 15 (8), 4212-4222.
- D. Ciolkosz, J. Desplat and K. Schiffer (2019). "Raw, torrefied, and alkaline-treated biomass as a sorbent for lead in water". *BioResources*, 14 (4), 8530-8542.
- D. Ciolkosz and R. Wallace (2011). "A review of torrefaction for bioenergy feedstock production". *Biofuels, Bioproducts and Biorefining*, 5 (3), 317-329.
- J.F. Dallemand, J.A. Hilbert and F. Monforti, "Bioenergy and Latin America: A Multi-Country Perspective".(2015).
- A. Dhungana, P. Basu and A. Dutta (2012). "Effects of reactor design on the torrefaction of biomass". *Journal of energy resources technology*, 134 (4),
- T.R.K.C. Doddapaneni, R. Jain, R. Praveenkumar, J. Rintala, H. Romar and J. Kontinen (2018). "Adsorption of furfural from torrefaction condensate using torrefied biomass". *Chemical Engineering Journal*, 334 558-568.
- T.R.K.C. Doddapaneni, R. Praveenkumar, H. Tolvanen, M.R. Palmroth, J. Kontinen and J. Rintala (2017). "Anaerobic batch conversion of pine wood torrefaction condensate". *Bioresource Technology*, 225 299-307.
- B. Emadi, K.L. Iroba and L.G. Tabil (2017). "Effect of polymer plastic binder on mechanical, storage and combustion characteristics of torrefied and pelletized herbaceous biomass". *Applied Energy*, 198 312-319.
- B. Fahimnia, J. Sarkis and H. Davarzani (2015). "Green supply chain management: A review and bibliometric analysis". *Int. J. Production Economics*, 162 14.

- Y.Y. Gan, H.C. Ong, P.L. Show, T.C. Ling, W.-H. Chen, K.L. Yu and R. Abdullah (2018). "Torrefaction of microalgal biochar as potential coal fuel and application as bio-adsorbent". *Energy Conversion Management*, 165 152-162.
- R.M. Gargouri, R. Shabou and C. Francoeur (2010). "The relationship between corporate social performance and earnings management". *Canadian Journal of Administrative Sciences*, 27 (4), 320-334.
- E. Giuliani (2005). "Cluster absorptive capacity: why do some clusters forge ahead and others lag behind?". *European urban and regional studies*, 12 (3), 269-288.
- S.H. Han, L. Meng, A. Rahman, Y. Ko, M.S. Cho and B.B. Park (2017). "Torrefied wood effects on the seedling quality of *Zelkova serrata* and *Fraxinus rhynchophylla* in a containerized production system". *Forest Science Technology*, 13 (4), 145-151.
- J.E. Hirsch and G. Bucla-Casal (2014). "The meaning of the h-index". *International Journal of Clinical Health Psychology*, 14 (2), 161-164.
- S.K. Hoekman, A. Broch and C. Robbins (2011). "Hydrothermal carbonization (HTC) of lignocellulosic biomass". *Energy & Fuels*, 25 (4), 1802-1810.
- IEA, "Perspectives for the Clean Energy Transition: The Critical Role of Buildings".(2019). International Energy Agency, 117.
- S. Kanwal, N. Chaudhry, S. Munir and H. Sana (2019). "Effect of torrefaction conditions on the physicochemical characterization of agricultural waste (sugarcane bagasse)". *Waste Management*, 88 280-290.
- J. Kiel, "Torrefaction for upgrading biomass into commodity fuel".(2011).
- B. Kitchenham, "Procedures for performing systematic reviews".(2004). Keele University, 1-26.
- J. Koppejan, S. Sokhansanj, S. Melin and S. Madrali, "Status overview of torrefaction technologies".(2012). 1-54.
- H.S. Lau, H.K. Ng, S. Gan and S.A. Jourabchi (2018). "Torrefaction of oil palm fronds for co-firing in coal power plants". *Energy Procedia*, 144 75-81.
- T. Mamvura and G. Danha (2020). "Biomass torrefaction as an emerging technology to aid in energy production". *Heliyon*, 6 (3), e03531.
- P. McNamee, P. Adams, M. McManus, B. Dooley, L. Darvell, A. Williams and J. Jones (2016). "An assessment of the torrefaction of North American pine and life cycle greenhouse gas emissions". *Energy Conversion and Management*, 113 177-188.
- D. Medic, M. Darr, B. Potter and A. Shah (2012). "Effect of torrefaction process parameters on biomass feedstock upgrading". *Fuel*, 91 8.
- F.G. Montoya, A. Alcayde, R. Baños and F. Manzano-Agugliaro (2018). "A fast method for identifying worldwide scientific collaborations using the Scopus database". *Telematics and Informatics*, 35 (1), 168-185.
- L.J. Nunes and J.C. Matias (2020). "Biomass Torrefaction as a Key Driver for the Sustainable Development and Decarbonization of Energy Production". *Sustainability*, 12 (3), 922.
- V. Ochoa, V. Guillermo, J.N. Alvarez and C. Acevedo (2019). "Research evolution on renewable energies resources from 2007 to 2017: a comparative study on solar, geothermal, wind and biomass energy". *International Journal of Energy Economics and Policy*, 9 (6), 12.

- T. Ogura, Y. Date, M. Masukujane, T. Coetzee, K. Akashi and J. Kikuchi (2016). "Improvement of physical, chemical and biological properties of aridisol from Botswana by the incorporation of torrefied biomass". *Scientific Reports*, 6 (1), 1-10.
- T. Onsree and N. Tippayawong (2020). "Torrefaction of maize residue pellets with dry flue gas". *BioEnergy Research*, 13 (1), 358-368.
- G. Pahla, F. Ntuli and E. Muzenda (2018). "Torrefaction of landfill food waste for possible application in biomass co-firing". *Waste management*, 71 512-520.
- E. Papadopoulou, P.J. de Wild, S. Kountouras and K. Chrissafis (2018). "Evaluation of torrefaction condensates as phenol substitutes in the synthesis of phenol-formaldehyde adhesives suitable for plywood". *Thermochimica Acta*, 663 27-33.
- C. Park, U. Zahid, S. Lee and C. Han (2015). "Effect of process operating conditions in the biomass torrefaction: A simulation study using one-dimensional reactor and process model". *Energy*, 79 127-139.
- M.-A. Perea-Moreno, E. Samerón-Manzano and A.-J. Perea-Moreno (2019). "Biomass as renewable energy: Worldwide research trends". *Sustainability*, 11 (3), 863.
- M.J. Prins, K.J. Ptasinski and F.J. Janssen (2006a). "More efficient biomass gasification via torrefaction". *Energy*, 31 (15), 3458-3470.
- M.J. Prins, K.J. Ptasinski and F.J. Janssen (2006b). "Torrefaction of wood: Part 2. Analysis of products". *Journal of analytical and applied pyrolysis*, 77 (1), 35-40.
- A. Pritchard (1969). "Statistical bibliography or bibliometrics". *Journal of documentation*, 25 (4), 348-349.
- S. Proskurina, J. Heinimö, F. Schipfer and E. Vakkilainen (2017). "Biomass for industrial applications: The role of torrefaction". *Renewable Energy*, 111 265-274.
- C. Rehn, U. Kronman, C. Gornitzki, A. Larsson and D. Wadskog, "Book Bibliometric Handbook for Karolinska Institutet". (2014).
- J.M.C. Ribeiro, R. Godina, J.C.d.O. Matias and L.J.R. Nunes (2018). "Future perspectives of biomass torrefaction: Review of the current state-of-the-art and research development". *Sustainability*, 10 (7), 2323.
- P. Rousset, F. Davrieux, L. Macedo and P. Perré (2011). "Characterisation of the torrefaction of beech wood using NIRS: Combined effects of temperature and duration". *Biomass and bioenergy*, 35 (3), 1219-1226.
- A. Sarvaramini, O. Gravel and F. Larachi (2013). "Torrefaction of ionic-liquid impregnated lignocellulosic biomass and its comparison to dry torrefaction". *Fuel*, 103 814-826.
- M.M.I. Sheikh, C.H. Kim, H.J. Park, S.H. Kim, G.C. Kim, J.Y. Lee, S.W. Sim and J.W. Kim (2013). "Effect of torrefaction for the pretreatment of rice straw for ethanol production". *Journal of the Science of Food Agriculture*, 93 (13), 3198-3204.
- M.A. Sukiran, F. Abnisa, W.M.A.W. Daud, N.A. Bakar and S.K. Loh (2017). "A review of torrefaction of oil palm solid wastes for biofuel production". *Energy Conversion and Management*, 149 101-120.
- M. Svanberg and Á. Halldórsson (2013). "Supply chain configuration for biomass-to-energy: the case of torrefaction". *International journal of energy sector management*,
- R. Swaminathan and F.N.P. Nandjembo (2016). "Design and Testing of a Solar Torrefaction Unit to Produce Charcoal". *Journal of Sustainable Bioenergy Systems*, 6 (03), 66.

- D. Tapasvi, R.S. Kempegowda, K.-Q. Tran, Ø. Skreiberg and M. Grønli (2015). "A simulation study on the torrefied biomass gasification". *Energy Conversion Management*, 90 446-457.
- N. Tippayawong, T. Onsree, T. Williams, K. McCullough, B. MacQueen and J. Lauterbach (2019). "Catalytic torrefaction of pelletized agro-residues with Cu/Al<sub>2</sub>O<sub>3</sub> catalysts". *Biomass Conversion and Biorefinery* 1-6.
- A.T. Ubando, D.R.T. Rivera, W.-H. Chen and A.B. Culaba (2019). "A comprehensive review of life cycle assessment (LCA) of microalgal and lignocellulosic bioenergy products from thermochemical processes". *Bioresource technology*, 291 121837.
- M. Van der Stelt, H. Gerhauser, J. Kiel and K. Ptasinski (2011). "Biomass upgrading by torrefaction for the production of biofuels: A review". *Biomass and bioenergy*, 35 (9), 3748-3762.
- N.J. Van Eck and L. Waltman (2010). "Software survey: VOSviewer, a computer program for bibliometric mapping". *Scientometrics*, 84 (2), 523-538.
- J. Wannapeera, B. Fungtammasan and N. Worasuwannarak (2011). "Effects of temperature and holding time during torrefaction on the pyrolysis behaviors of woody biomass". *Journal of Analytical and Applied Pyrolysis*, 92 (1), 99-105.
- W.B.A. WBA, "Global Bioenergy Statistics".(2019). Bioenergy Europe,
- Y. Yang, M. Sun, M. Zhang, K. Zhang, D. Wang and C. Lei (2019). "A fundamental research on synchronized torrefaction and pelleting of biomass". *Renewable Energy*, 142 668-676.
- Q. Zhang, J. Hu and D.-J. Lee (2017). "Pretreatment of biomass using ionic liquids: research updates". *Renewable Energy*, 111 77-84.



# Evaluation of Equity-linked structured products and pricing

**Chaitali Kotadia**

Sr. Finance Analyst, Finance Department, MSD (UK) Ltd.

London, United Kingdom

Email: laduchaitali@gmail.com

## Abstract

*Based on a unique data set, this research paper examines the pricing of equity-linked structured products in the market. The following section of this paper look at examining a few popular products available in the market, describing their key characteristics, and identifying one such product which will be examined closely for the purposes of determining if the issuing institution has priced the same fairly. The daily closing prices of a large variety of structured products are compared to theoretical values derived from the prices of options traded on the Eurex (European Exchange). This research paper also provides a brief background on the pricing of equity-linked structured products ('products') and issues around valuation of these products and look in detail fair pricing of the zero-coupon bond and the basket option. Comparing this with the market price of the instrument I could draw conclusions based on how close the real market price of the instrument is with the recomputed price.*

**Keywords** – Structured products, Pricing, Option, Implied Volatility

## 1. Introduction

Equity-linked structured products are derivative instruments wherein the underlying asset is an equity security. Although every product is different in several ways all of them promise tailor made risk return profiles. Even though equity derivatives are amongst the oldest form of derivatives, structured equity products gained popularity in Europe only in the mid- 1990's during a period of low interest rates. The market today for these products has become extremely complex and has evolved significantly from traditional single stock equity derivatives to index-based products. Traditional forms of equity derivatives were generally used to raise equity capital for companies; today these products are increasingly being used in the process of debt fund raising through new issue arbitrage techniques. Most forms of equity linked structured products have their performance linked to an underlying benchmark such as an equity index, real estate index, commodities, interest rates etc. For instance, a FTSE 100 linked note will have returns linked to the FTSE 100 index and consequently the better the FTSE 100 performs the better will be the returns of the note. Another common feature of many structured products is capital protection. A capital protected structured product protects a portion (up to 100%) of the capital invested, making the product very desirable for retail investors with a low-risk appetite. Some of the major reasons for the rapid evolution of these products include changes in the pattern of equity investments including the increased importance of indexed strategies and increase in cross border investments, demand for customized equity investments and structured equity risk profiles, tax factors, including the optimization of after-tax returns from equity

instruments.

The Structured Products Association (SPA) estimates \$45 to \$50 billion worth of products were deposited within the U.S. in 2005 which there will be a 20% to 25% growth in 2006. In terms of listed registered products, the American Stock Exchange has reported an 18 percent increase in the number of structured product issues listed in 2005 on the exchange over 2004, bringing the notional number of structured products on the AMEX to over 13 billion. Despite the large size and rapid growth of the market for these products, very little empirical research has been conducted on pricing.

The following paragraphs list out a few studies conducted on re-pricing of structured products:

Chen and Kensinger (1990) for a period of two months in 1988 and 1989 have conducted an analysis of 'Market-Index-Certificate of Deposit' (MICD) within the US market, which guaranteed a minimum rate and a variable rate pegged to the performance of S&P 500. A comparison of the implied volatility of the S&P 500 option with the implied volatility of the (MICD)'s option components revealed significant positive and negative differences between theoretical and market values.

Chen and Sears (1990) investigated the exchange traded 'S&P 500 Index Note' (SPIN) issued by the Salomon Brothers. Computing the differences between market and model prices for the period 1986 to 1987 they diagnose overpricing in the first sub-period and under-pricing in the second and third sub-periods.

Baubonis et al (1993) analyze the cost structure of equity-linked certificates of deposits and demonstrate, using Citicorp product as an example that the bank can earn 2.5%-4% of the selling price in the primary market. Wasserfallen and Schenk (1996) examine the pricing of capital protected products issued in 1991-1992 in the Swiss market. The comparison of the products option components from those derived from historical and implied volatility of country Market Index shows that the securities are sold slightly above the theoretical value. In the secondary market, model values exceeded observed prices. In all the above-mentioned studies the authors have found overpricing of structured equity products in the favor of the issuing institution. The purpose of this study is to undertake a firsthand investigation of a sample of equity linked structured products (hereinafter referred to as 'products') and analyze product from the selected sample.

## **2. An Overview of Types of Products Available**

There is no formal definition of a structured product however for the purpose of this study the focus is maintained on the market for equity linked products, i.e., instruments with stocks or stock indices as underlying. At a macro level 'products' can be classified as ones with plain-vanilla option components and ones with Exotic option components. Another way of classifying these 'products' are by their objectives, i.e., growth products: which may provide some or 100 percent capital protection and income products: which promise high fixed income but carry risk on capital return (no capital protection) For this study, the discussion will remain focused around 'Capital-Guaranteed Products'. In the following sections different variant of 'Capital-Guaranteed Products' are described. Most Capital Protected Products are redeemable with a minimum guaranteed percentage of the face value (often 100%), have low or no interest rates and

promise participation in the performance of an underlying asset. Investor participation in the performance of the underlying asset can take a wide variety of forms which allows creation of a variety of Capital Protected Products.

The most basic form of this type of an instrument is where the investor is guaranteed a percentage of the principal invested and participation in the percentage of growth of the underlying asset.

This can also be expressed as the following formula:

$$\begin{aligned} R &= N \cdot \left( 1 + \max\left(0; \frac{S_T - S_0}{S_0}\right) \right) = \\ &= N + \frac{N}{S_0} \cdot \max(0; S_T - S_0) \end{aligned} \quad (1)$$

where,

R redemption amount

N face value

S<sub>0</sub> original price of underlying asset

S<sub>T</sub> price of underlying asset at maturity

Such products will have several European call options on the underlying asset embedded in them. The number of call options is equal to the face value of the instrument divided by the initial price. In summary the instrument can be interpreted as a combination of zero-coupon bonds with European options.

Most of the other types of Capital Protected Products are essentially permutations and combinations of zero-coupon bonds with all conceivable types of options depending on what the product sets out to achieve.

## ***2.1 Capital Protected Products Using European Call Options***

### **Background:**

These instruments as described above are the simplest of Capital Protected Products. They guarantee a percentage of the principal sum invested (often up to 100%) plus a return which depends on the performance of the underlying asset and the agreed participation in the performance of the underlying asset. If the price of the underlying asset increases the investor stands to gain while on the other hand if the price drops the investor enjoys capital protection.

**Example:** ATX guarantee certificate 1998–2000

Maturity	November 24, 1998, to July 25, 2000 (1 year, 8 months)
Redemption rate	Face value * (1 + b * ((ATX <sub>T</sub> - ATX <sub>0</sub> ) / ATX <sub>0</sub> )), at least a% of face value
Participation	b = 50%
Capital guarantee	a = 95%
ATX <sub>0</sub>	value of the ATX on November 24, 1998
ATX <sub>T</sub>	value of the ATX on July 25, 2000
Issue price	100%
Denomination	EUR 1,000

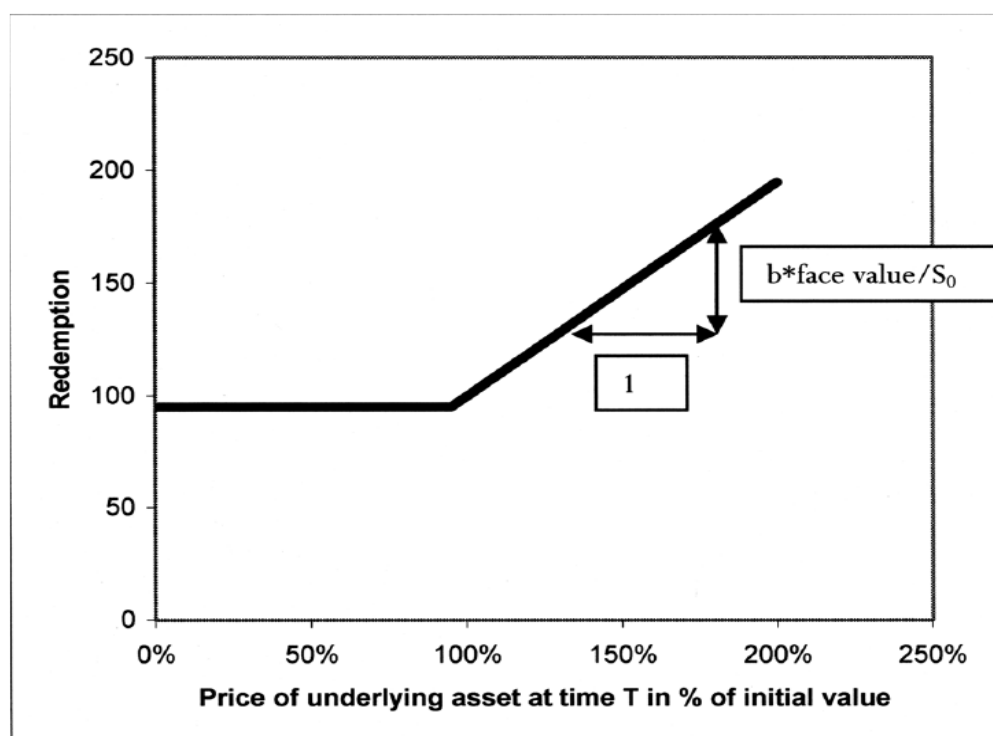


Figure 1. (Example of the Capital Protected Product and diagram showing payoff profile taken from ‘Financial Instruments –The Structured Products Handbook’ Oesterreichische Nationalbank)

**Replication**

This product can be broken down into a zero-coupon bond and a European Call Option.

Redemption in this case can also be described mathematically as:

$$\begin{aligned}
 R &= \max \left( N \cdot a; N \cdot \left( 1 + b \cdot \frac{S_T - S_0}{S_0} \right) \right) = \\
 &= N \cdot a + \frac{N}{S_0} \cdot \max(0; (1 - a) \cdot S_0 + b \cdot (S_T - S_0)) = \\
 &= N \cdot a + \frac{N \cdot b}{S_0} \max \left( 0; S_T - S_0 \left( 1 - \frac{1 - a}{b} \right) \right)
 \end{aligned} \tag{2}$$

where,

R redemption amount

N face value

$S_0$  original price of underlying asset

$S_T$  price of underlying asset at maturity

a guaranteed redemption amounts

b participation rate

The product can be replicated as follows:

$$\boxed{\begin{aligned} &+ \text{Capital-guaranteed bonds with} = + \text{zero coupon bonds} \\ &\text{embedded European call option} \quad + \frac{\text{face value} \cdot b}{S_0} \text{ European call options} \end{aligned}} \quad (3)$$

The strike price of the option is:

$$S_0 \left( 1 - \frac{1-a}{b} \right) \quad (4)$$

Assuming a principal of 1,000, we can replicate this instrument with:

- The purchase of a zero-coupon bond which reaches maturity on July 25, 2000 and has a face value of EUR 950
- The purchase of  $1,000 \cdot 0.5 / \text{ATX}_{\text{nov 24, 98}}$  European call options on the ATX with a strike price of  $0.9 \left( \frac{1}{4} 1 - (1-a) / b \right) \cdot \text{ATX}_{\text{nov 24, 98}}$  and expiring on July 25, 2000

## Valuation

Zero coupon bonds are valued using the relevant spot rates. Black-Scholes model gives a closed formula for calculating option premium. Assuming that the currency of the bond and that of the underlying asset are the same:

$$c = Se^{-qT}N(d_1) - Xe^{-rT}N(d_2)$$

where

$$\begin{aligned} d_1 &= \frac{\ln(S/X) + (r - q + \sigma^2/2)T}{\sigma\sqrt{T}} \\ d_2 &= d_1 - \sigma\sqrt{T} \end{aligned} \quad (5)$$

$c$	premium of a European call option on one share with price $S$ at $t = 0$ . $X$ is the exercise price, and the option expires in $T$ years.
$r$	risk-free interest rate (constant) over the period of the option
$q$	dividend yield
$\sigma$	volatility of the stock
$N(d)$	cumulative standard normal distribution at $d$

## 2.2 Capital Protected Products using European Put Options

### Background:

Capital Protected Products with embedded European put options are generally characterized by 100% capital protection plus a percentage return based on the difference in underlying asset's price between the issue and maturity date.

The percentage return is paid only if the price of the underlie drops, while on the other hand the investor enjoys capital protection if the price rises.

### Example: ATX guarantee certificate 1998–2000

Maturity	November 24, 1998, to July 25, 2000 (1 year, 8 months)
Redemption rate	Face value * $(1 + b * ((ATX_0 - ATX_T) / ATX_0))$ , at least $a\%$ of face value
Participation	$b = 50\%$
Capital guarantee	$a = 95\%$
$ATX_0$	value of the ATX on November 24, 1998
$ATX_T$	value of the ATX on July 25, 2000
Issue price	100%
Denomination	EUR 1,000



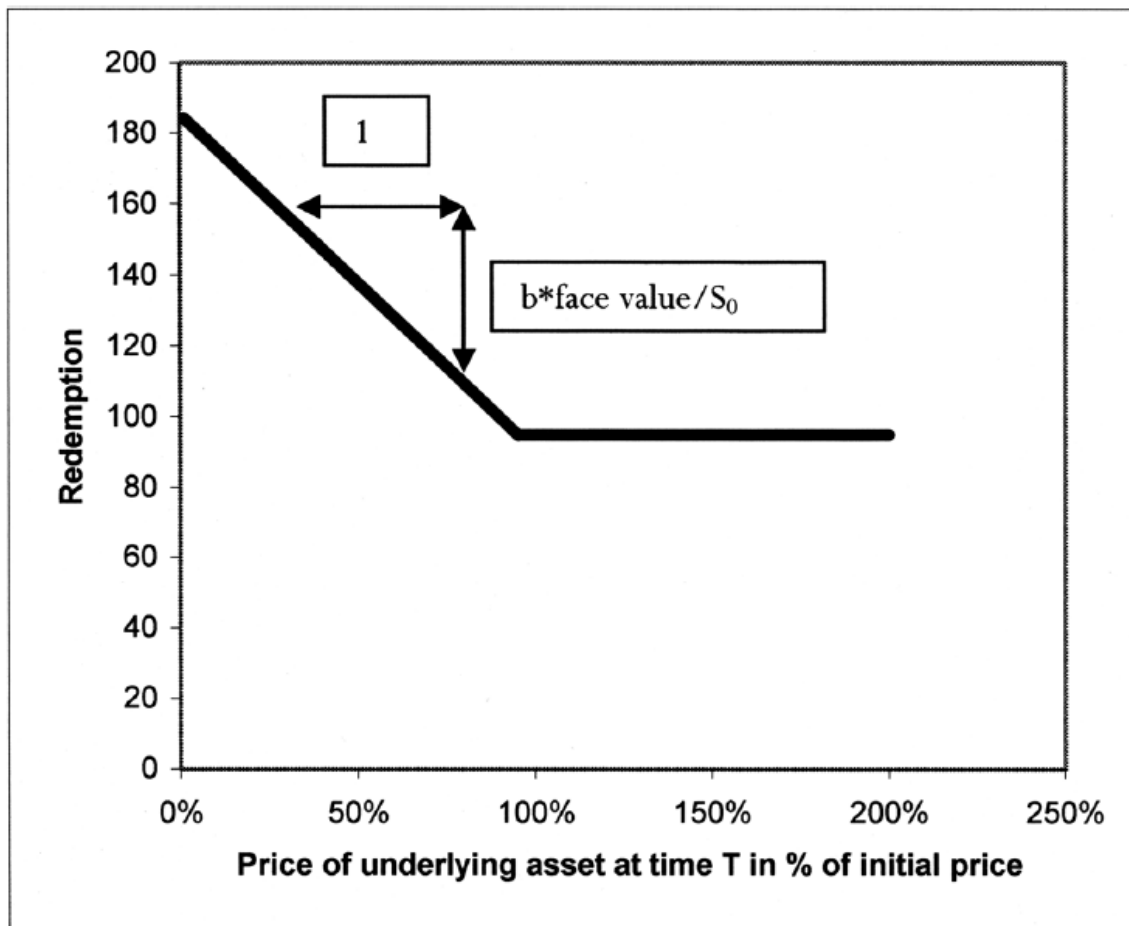


Figure 2. (Example of the Capital Protected Product and diagram showing payoff profile taken from 'Financial Instruments –The Structured Products Handbook' Oesterreichische Nationalbank)

### Replication

As explained in section 3.1, the Capital Protected Product can be broken into components of a zero-coupon bond and European Put Option.

Redemption in this case can also be described mathematically as:

$$\begin{aligned}
 R &= \max\left(N \cdot a; N \cdot \left(1 + b \cdot \frac{S_0 - S_T}{S_0}\right)\right) = \\
 &= N \cdot a + \frac{N}{S_0} \cdot \max(0; (1 - a) \cdot S_0 + b \cdot (S_0 - S_T)) = \\
 &= N \cdot a + \frac{N \cdot b}{S_0} \max\left(0; \left(1 + \frac{1 - a}{b}\right) \cdot S_0 - S_T\right)
 \end{aligned} \tag{6}$$

where,

R redemption amount

N face value

S<sub>0</sub> original price of underlying asset

S<sub>T</sub> price of underlying asset at maturity

a guaranteed redemption amounts

b participation rate

The product can be replicated as follows:

$$\begin{aligned} &+ \text{Capital-guaranteed bonds with} = + \text{zero coupon bonds} \\ &\text{embedded European put option} \quad + \frac{\text{face value} \cdot b}{S_0} \text{European put options} \end{aligned} \quad (7)$$

The strike price of the option is:

$$S_0 \left( 1 + \frac{1-a}{b} \right) \quad (8)$$

Assuming a principal of 1,000, we can repeat this instrument with:

- The purchase of a zero-coupon bond which reaches maturity on July 25, 2000, and has a face value of EUR 950
- The purchase of  $1,000 \cdot 0.5 / \text{ATX}_{\text{Nov 24, 98}}$  European put options on the ATX with a strike price of 1.1  $(= 1 - (1-a) / b) \cdot \text{ATX}_{\text{Nov 24, 98}}$  and expiring in July 25, 2000

## Valuation

Zero coupon bonds are valued using the relevant spot rates. Black-Scholes model gives a closed formula for calculating option premium. Assuming that the currency of the bond and that of the underlying asset are the same:

$$p = Xe^{-rT}N(-d_2) - Se^{-qT}N(-d_1)$$

where

$$\begin{aligned} d_1 &= \frac{\ln(S/X) + (r - q + \sigma^2/2)T}{\sigma\sqrt{T}} \\ d_2 &= d_1 - \sigma\sqrt{T} \end{aligned} \quad (9)$$

$p$	premium of a European put option on one share with price $S$ at $t = 0$ . $X$ is the exercise price, and the option expires in $T$ years.
$r$	risk-free interest rate (constant) over the period of the option
$q$	dividend yield
$\sigma$	volatility of the stock
$N(d)$	cumulative standard normal distribution at $d$

## 2.3 Capital Protected Products using asian options (average rate options)

### Background:

Where a Capital Protected Product has an embedded Asian option, the amount paid out at maturity depends on the average value of the underlying asset. This average is calculated using prices of the underlying at regular intervals.

**Example: Equity-linked bond**

Maturity	November 30, 1998, to November 29, 2003 (5 years)
Redemption rate	face value ( $N$ ) + bonus return $\text{Bonus return} = N \times \max\left(0; 60\% \cdot \frac{\bar{\Delta} ATX_T - ATX_0}{ATX_0}\right)$
Participation	$b = 60\%$
Capital guarantee	100%
$ATX_0$	closing value on November 30, 1998
$\bar{\Delta} ATX_T$	arithmetic mean of 20 quarterly prices, starting on November 30, 1998, plus the price on November 17, 2003 (21 observation dates).
Issue price	100%
Denomination	EUR 1,000

Table 1. Example of the Capital Protected Product and diagram showing payoff profile taken from 'Financial Instruments –The Structured Products Handbook' Oesterreichische Nationalbank

Depending on whether an Asian call or put option is embedded, the redemption amount is calculated using one of the following formulas:

(1) Call option (see example):

$$R = N + N \cdot \max\left(0; b \cdot \left(\frac{\bar{\Delta} S_T - S_0}{S_0}\right)\right)$$

or

$$R = N + \frac{N \cdot b}{S_0} \cdot \max(0; \bar{\Delta} S_T - S_0)$$

(2) Put option:

$$R = N + N \cdot \max\left(0; b \cdot \left(\frac{S_0 - \bar{\Delta} S_T}{S_0}\right)\right)$$

or

$$R = N + \frac{N \cdot b}{S_0} \cdot \max(0; S_0 - \bar{\Delta} S_T) \quad (10)$$

where

R redemption amount

N face value

$S_0$  initial value of underlying asset

$\bar{S}_T$  average value at maturity

$b$  participation rate

An Asian option (also called an average option) is an option whose payoff is linked to the average value of the underlier on a specific set of dates during the life of the option. There are two basic forms:

An **average rate** option (or average price option) is a cash-settled option whose payoff is based on the difference between the average value of the underlier during the life of the option and a fixed strike.

An **average strike** option is a cash settled or physically settled option. It is structured like a vanilla option except that its strike is set equal to the average value of the underlier over the life of the option ([http://www.riskglossary.com/link/asian\\_option.htm](http://www.riskglossary.com/link/asian_option.htm))

### **Replication:**

The product can be replicated as follows:

Assuming a principal of 1,000, we can replicate this instrument with:

- The purchase of a zero-coupon bond which reaches maturity on November 29, 2003, and has a face value of EUR 1,000
- The purchase of  $1,000 * 0.6 / \text{ATX}_{\text{nov 30, 98}}$  Asian call options on the ATX with a strike price of  $\text{ATX}_{\text{nov 30, 98}}$  and expiring on November 29, 2003

### **Valuation**

The zero-coupon bonds are valued using the relevant spot interest rates. Asian options for which payments are based on a geometric average are relatively easy to value. A closed-form valuation formula exists, the zero-coupon bonds are valued using the relevant spot interest rates. Asian options for which payments are based on a geometric average are relatively easy to value. A closed-form valuation formula exists.

However, because the interest on bonds with Asian options generally depends on the arithmetic average value of the underlying asset, this straightforward formula can't be used to determine the precise value. As the arithmetic average of a log-normally distributed value is itself not log-normally distributed, these options can only be valued using numerical procedures or with the help of analytical approximation.

Approximations have been developed by Turnbull and Wakeman (1991), Levy (1992) and Curran (1992), for example. E. G. Haug, *"The Complete Guide to Option Pricing Formulas"*, 1997, McGraw-Hill, (p. 96,97) In Curran's model, the value of an Asian option can be approximated using the following formula:

$$\begin{aligned}
c &\approx e^{-rT} \left[ \frac{1}{n} \sum_{i=1}^n e^{\mu_i + \sigma_i^2/2} N\left(\frac{\mu - \ln(\hat{X})}{\sigma_x} + \frac{\sigma_{xi}}{\sigma_x}\right) - X N\left(\frac{\mu - \ln(\hat{X})}{\sigma_x}\right) \right] \\
\mu_i &= \ln(S) + (r - q - \sigma^2/2)t_i \\
\sigma_i &= \sqrt{\sigma^2[t_1 + (i-1)\Delta t]} \\
\sigma_{xi} &= \sigma^2\{t_1 + \Delta t[(i-1) - i(i-1)/(2n)]\} \\
\mu &= \ln(S) + (r - q - \sigma^2/2)[t_1 + (n-1)\Delta t/2] \\
\sigma_x &= \sqrt{\sigma^2[t_1 + \Delta t(n-1)(2n-1)/6n]} \\
\hat{X} &= 2X - \frac{1}{n} \sum_{i=1}^n \exp\left\{\mu_i + \frac{\sigma_{xi}[\ln(X) - \mu]}{\sigma_x^2} + \frac{\sigma_i^2 - \sigma_{xi}^2/\sigma_x^2}{2}\right\}
\end{aligned} \tag{11}$$

Where,

$c$	premium of an Asian call option
$S$	current value of underlying asset
$X$	strike price
$r$	risk-free interest rate (constant) over the period of the option
$q$	dividend yield
$T$	term in years
$t_1$	first observation point
$t$	time between observation points
$n$	number of values sampled
$\sigma$	volatility of the underlying asset
$N(d)$	cumulative standard normal distribution at $d$

Curran's approximation for Asian Call options

## 2.4 Capital Protected Products using capped call options

### Background:

Theoretically the redemption amount for a capital protected product with an embedded call option can be infinitely high. The product described in this section places a cap, expressed as a percentage of the instrument's face value, on the redemption amount. In this way the bearer only participates in the relative performance of the underlying asset up to a certain maximum value.

In cases where the price of the underlying asset decreases, the issuer guarantees a minimum redemption amount.

**Example: “Europa” guarantee certificate**

Maturity	December 15, 1998, to December 13, 2002 (4 years)
Redemption rate	The redemption rate (expressed as a percentage of the face value) is proportionate to the change in the underlying asset's price ( $S_T/S_0$ ); minimum 100%, maximum 109%; or, expressed as a formula: $T = \text{face value} * (100\% + \min(9\%; \max(0\%; (S_T - S_0)/S_0)))$
$S_0$	closing price of XY stock on December 15, 1998
$S_T$	closing price of XY stock on December 13, 2002
Issue price	100%
Denomination	EUR 1,000

Table 2. Example of the Capital Protected Product and diagram showing payoff profile taken from ‘Financial Instruments –The Structured Products Handbook’ Oesterreichische Nationalbank

If the price of the underlying asset increases between the issue date and the maturity date, then the investor will participate up to a rate of 9%.

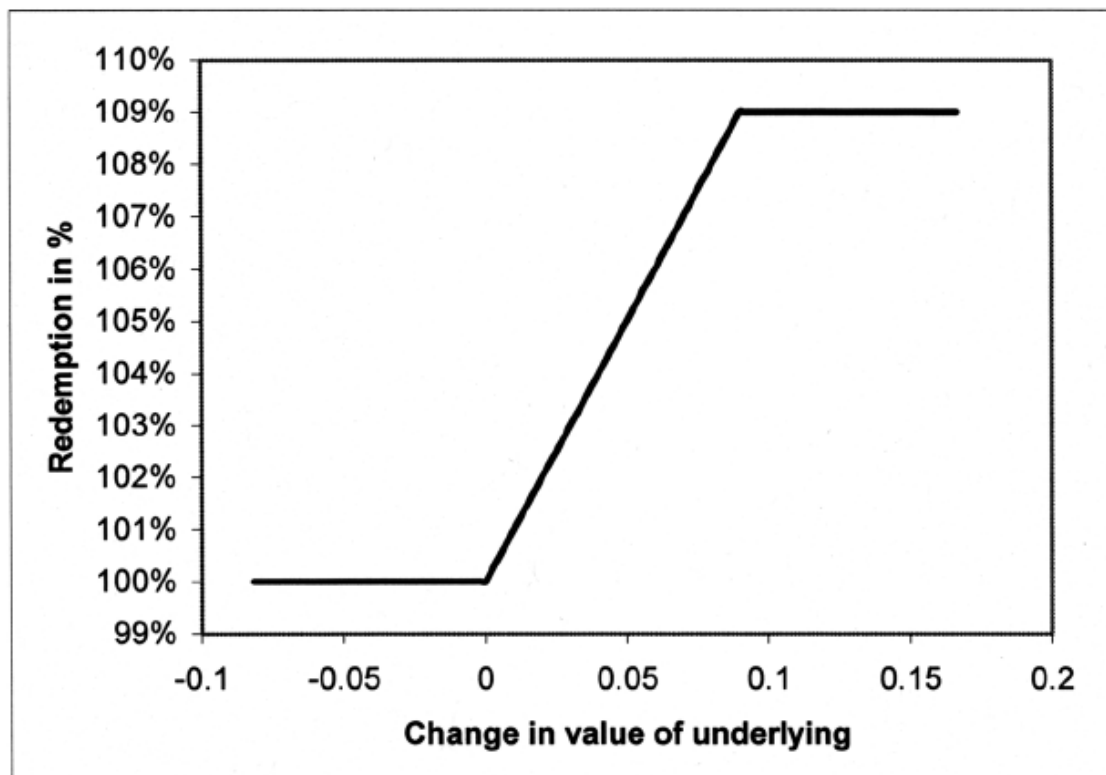




Figure 3. Guaranteed redemption at 100%, participation in positive changes in the underlying asset's price, maximum redemption rate 109%. (The payoff pattern in the illustration precisely reflects the redemption in the example.)

### Replication:

Assuming a principal of 1,000, we can replicate this instrument with:

- The purchase of a zero-coupon bond which reaches maturity on December 13, 2002, and has a face value of EUR 1,000
- The purchase of  $1;000 = S_0$  European call options on the underlying asset with a strike price of  $S_0$ , expiring on December 13, 2002
- The sale of  $1;000 = S_0$  European call options on the underlying asset with a strike price of  $1.09S_0$ , expiring on December 13, 2002

### Valuation:

Valuation of this type of a product can be analyzed in the same way as described in section 3.3. i.e. by breaking down the product into zero coupon bonds and European call options.

## 3. Theoretical Aspects of Volatility

Volatility is a measure of price variability over some period. It typically illustrates the standard deviation of returns, in a particular context that depends on the definition used. Alternatively, we can say that volatility is the standard deviation of the change in the logarithm of a price or a price index during a stated period. Volatility can be defined and interpreted in different ways.

### Realized volatility

Realized volatility, also called historical volatility, is the standard deviation of a set of previous returns. This volatility can be stated in annual units as standard deviation (for  $n$  trading periods with  $r$  returns) times the square root of  $N$ , where  $N$  denotes the number of trading days in a year.

### Conditional Volatility

Conditional volatility is that the standard deviation of future return that is conditional on known information like the history of previous returns. Unlike realized volatility, the expectation for the subsequent period is calculated using a time series model that has been selected and estimated using appropriate data.

**Stochastic volatility** processes are motivated by noting that volatility is not constant and hence it is interesting to try to specify how volatility changes through time. Typical discrete-time models suppose that volatility is unobservable and so its stochastic properties could also be inferred from either absolute or squared returns. Continuous-time models are used to price options when the assumption of constant volatility is relaxed.

A square root process for volatility permits the rapid calculation of appropriate option prices.

**Implied volatility** is a value calculated from an option price. It equals the volatility parameter  $\sigma$  for which an option's market price equals its theoretical price according to a pricing formula. The Black-Scholes pricing formula provides theoretical prices for European Call options, say  $c(\sigma)$ , and assumes that the asset price process is Geometric Brownian Motion with annual variance rate  $\sigma^2$ . As  $c(\sigma)$  is an increasing function of  $\sigma$ , for any market price  $c_M$  between the lower and upper bounds that exclude arbitrage profits there is a unique solution to the equation  $c_M = c(\sigma)$  that defines the implied volatility.

These volatility measures depend on the time until expiry and the exercise price of an option.

At any time, the values of realized volatility, conditional volatility, unobservable stochastic volatility, and implied volatility will usually all be different, because different data and assumptions are employed when these values are calculated.

### The Theta

The effect of a change in time to expiration on the theoretical values of calls and puts is called theta. All options, both calls and puts, lose value as expiration approaches. The *theta*, or time decay factor is the rate at which an option loses value as time passes. It is usually expressed in points lost per day when all other conditions remain the same. An option with theta of 0.5 will lose 0.5 in value for each day that passes with no change in other market conditions. If the option is worth 2.75 today, then tomorrow it will be worth 2.17. The day after that it will be worth 2.65. Time runs only in one direction and technically, theta is a positive number. However, theta sometimes is written as a negative number, consequently, a long option position will always have negative theta and short option position will always have positive theta. This is just the opposite of gamma, where a long option position will have positive gamma, and a short option position has a negative gamma.

Every option position is a trade off between market movements and time decay. If the price movement in the underlying contract will help a trader (positive gamma) the passage of time will hurt (negative theta) and vice versa.

### The Vega

The vega of an option is usually given in point change in theoretical value for each 1%-point change in volatility. Since all options gain value with rising volatility the vega for both calls and puts is positive. If an option has a vega of 0.15, for each percentage point increase (decrease in volatility) the option will gain (lose) 0.15 in theoretical value and at-the-money option always has a greater vega than either an in-the-money or out-of-the-money option when all options are of the same type and have the same amount of time to expiration. This means that an at-the-money option is always the more sensitive in total points to a change in volatility.

### 3.1 Buying and Selling Volatility:

To make a profit, most individual investors and fund managers are forced to take a view on the direction of the price of something. The traditional or fundamental strategy is to study all aspects of the marketplace and decide on the value of the investment vehicle under study. However, whether following fundamental

analysis or technical analysis or a combination of both, the ultimate investment decision is to buy or sell something. The traditional investor must take a view on the direction of the price.

If one is right a profit is enjoyed, if not loss is suffered. Between entering and exiting the trade many things can and often do happen. The price of the instrument may rise or fall. The price may begin to fluctuate violently or become moribund. Price may collapse 50%, stay at this depressed level for several months only then to rise in an orderly fashion and the settle back to the original entry level.

The value of the investment will vary from day to day to a greater or lesser extent looking on market conditions.

The view taker in a sense is looking at only one dimension of a price sequence – the direction. The view taker, once in, is just looking for an exit point. He needs to get the direction of this dimension correct. However, there is another dimension to investment – trading the volatility of a price and not the direction. The position of a volatility trader is such that on entering a position in each stock it does not matter whether the price goes up or down. (Connolly, 1999)

### ***3.2 The Long Volatility Trade:***

There are many different types of portfolios that will profit from volatility in each stock price but by far the most straight-forward is that of being long a call option and short shares.

To discuss the mechanics of buying volatility it is assumed that the price of the stock in question will fluctuate excessively. Assuming that it is known for sure that which ever way the price moves, it will be large and there will be many swings in price. Unfortunately, the investor does not know which direction the price will move and when the direction will change. The investor needs to get into a position which will profit whichever way the market moves, up or down. To achieve this the investor has to start with a position which is initially market neutral but gets long if the market rises and gets short if the market falls. The answer is to have a portfolio long of one option contract and to be simultaneously short the number of shares contained in one option contract. In this way the stock exposures of both components are identical in sign and must cancel out. This is referred to as a long volatility or hedged portfolio. In rising markets losses made on shorting stocks will have to be subtracted from option profits, conversely in falling markets profits made on shorting stocks will have to be added to option losses. If the stock price rise is small, the option profits are almost whacked out by short stock losses. If the stock price fall is small, the stock profits are almost completely whipped out by option losses. Hence for small price moves, up or down no profit or loss results. The position is perfectly hedged. The holder is such a position is said to be market neutral or delta neutral. If the stock price rises significantly, the option component always makes more than is lost by the stock component. If the stock price falls significantly, the profit on the short stock component always exceed the loss on the option component. The bigger the move up or down, the bigger the profit. Whichever way the stock price moves, the long volatility trader will always make a profit.

### 3.3 The Short Volatility Trade:

In the section above, a simple long volatility trade was discussed in which the strategy was to capitalise on future volatility in the stock price. If the option was cheap enough and/or the future volatility was high a profit would have resulted. However, to make a positive profit the circumstances would have to be right. Sometimes the investor might take a view that the options are very expensive and/or the stock volatility is going to fall. Paying up for expensive option premiums and witnessing little or no market movements may produce losses. If the options are expensive enough the investor may choose to take the opposite position and **sell volatility**. The short volatility strategy is exactly the opposite of the long volatility strategy in every respect and can produce profits. The basic strategy involves selling call options and hedging with a long position in the stock. Selling expensive options can produce significant returns and the short volatility player sells options within the hope that the premium he receives over covers any future price movements. Simply selling naked call options can be very risky. As with the long volatility play it is assumed that the investor has no view on the direction of the underlying and so a simple short volatility portfolio will have short call options perfectly hedged with a long stock position. The following section discusses what happens to the portfolio under two scenarios. If the stock price rises, a loss is suffered on the short call and a profit is enjoyed on the long stock. If the stock price falls, a profit is enjoyed on the short call and a loss is suffered in the long stock. It is easy to see that the net profit and loss to the hedged portfolio will be the difference between the two value profiles. If the stock price rise is small, the option losses are completely cancelled by the profit on the long stock. If the stock price fall is small the option profits are completely cancelled by the losses on the long stock. The portfolio is perfectly hedged and remains so with small stock price moves. If the stock price rises significantly, the option component always loses more than is made by the stock component. If the stock price falls significantly, the losses on the stock component always exceed the profits on the option component. The bigger the move, up or down, the bigger the losses. After entering this position, the investor would hope for little or no stock price movement until expiry. And therefore, the strategy is called the short volatility trade. The reason the portfolio always produces losses whatever the direction of the underlying is again due to the curvature of the option price. In the short volatility portfolio, the curvature of the option is the opposite of that in the long volatility portfolio.

## 4. Managing Correlation Risk:

Correlation risk refers to the risk of a financial loss when correlation in the market changes. It plays a central role in risk management and the pricing of basket derivatives. In risk management, correlation risk refers to the danger of a loss in a very financial position occurring because of a difference between anticipated correlation and realized correlation. Particularly, this happens when the estimate of correlation was wrong or the correlation within the market changed. Sophisticated structured equity derivatives houses have shed up to 10% of their short correlation risk positions to hedge funds using a new instrument called a **correlation swap**. Dealers structuring equity products for retail investors have built up significant short equity correlation positions in the year 2004, estimated to be as large as €200 million per percentage point of correlation – or €10 billion at one-year Eurostoxx implied correlation levels. The sheer size of those one-

way positions, also termed ‘book axe’, led to fears that dealers would be forced to scale down their activity in providing retail structured products

This potentially threatened the profitability of several investment banks, especially SG, which most dealers believe has the biggest short correlation positions – something that became particularly acute because the equity market rally within the year 2004 accentuated the short positions. But the French bank has innovated its way out of the problem and inspired several of its competitors to mimic its latest new trade – the correlation swap. These instruments typically dated between one-to-three years, and priced between €250,000 to €1 million per correlation point, require the dealers to structure a bespoke basket of 10 to 35 individual names where the dealer has significant correlation risk. It then sells the risk to hedge funds, and SG has laid off as much as 20% of its short correlation risk.

SG conducted its first deal in 2002, with an undisclosed large international reinsurer. While reinsurers have retreated from the market, hedge funds, pension funds and other real-money investors have stepped in to take the other side of correlation swaps. Unlike credit correlation trades, equity correlation is still relatively infrequently traded. And the correlation swaps are attractive to investors due to their exposure solely to correlation. For example, a one-year correlation swap on the Eurostoxx 50 index might have an implied correlation of 47%. If the trade is agreed at €1 million per percentage point, the dealer would pay the hedge funds €47 million on expiry. Should the realized correlation fall during that year to 43%, the hedge fund would pay the dealer €43 million. So, the trade would settle with the dealer paying the hedge fund €4 million. Correlation has become an increasingly familiar concept for hedge funds trading dispersion strategies using vanilla equity options. Here an investor trades an index versus its components or a subset of its components – for example, the Eurostoxx versus its 50 underlying or 20 of them. Dispersion trades are used by hedge funds most commonly as a vega-spread transaction with the correlation position forming an intrinsic part of the deal.

As index volatility has increased significantly relative to single-stock volatility, implied correlations have spiked sharply. The expectation is that the implied correlation level of 50% on the Eurostoxx 50 is rarely realized (see graph below).

Typically, vanilla option transactions have a listed expiry date, so there is a high level of transparency within the market and hedging is straightforward and comparatively cheap.

There are liquidity issues in some single-stock options and a desire to observe corporate actions. But perhaps the most important cost to hedge funds is that the investment required to risk-manage positions: As a result, many funds have used variance swaps to put dispersion trades. Variance swaps are useful to hedge funds as they do not need to develop the risk management and trading infrastructure required to delta hedge their positions. But the downside is that the use of variance swaps can prove more expensive – about 1.7% to 2% more than using vanilla instruments, according to industry participants. In addition, the whole skew of correlation is built into the pricing when using variance dispersion, whereas the implied correlation is different between strikes for vanilla options – for example, the 90% strike on Eurostoxx has a higher implied correlation than the at-the-money implied correlation.

But the purest way to take a correlation position is through correlation swaps. They are also the only way to gain direct longer-dated exposure – one-to-three years versus less-than-a-year for variance swaps. The main downside is that they are extremely illiquid products that are hard to mark-to-market

Unlike European options, where the gamma profile is linked to strikes, correlation swaps offer constant correlation sensitivity regardless of underlying equities moves – they are lever-independent



Figure 4

For example, when Finnish telecommunications company Nokia reported that first-quarter sales fell 2%, causing its share price to tumble 15% to €14.70 on April 6, with only a corresponding 0.9% fall in the Eurostoxx index – a relatively uncorrelated move – dealers' short correlation made money.

Correlation swaps are proving to be a vital risk management tool for structured product houses.

## 5. Monte Carlo Simulation:

In this section the Monte Carlo method is described and two techniques for improving the efficiency of the method are discussed.' An excellent exposition of the Monte Carlo method is given by Hammersley and Handscomb (1964). Shreider (1966). Fishman (1973) and Meyer (1956) provide additional useful references. It is convenient to couch the discussion in terms of the evaluation of a definite integral although Monte Carlo methods have a much wider range of applicability. Consider the integral

$$\int_A g(y)f(y) dy = \bar{g}, \quad (12)$$

where  $g(y)$  is an arbitrary function and  $f(y)$  is a probability density function with

$$\int_A f(y) dy = 1. \quad (13)$$

$A$  denotes the range of integration and is omitted for convenience in the sequel. To obtain an estimate of  $\bar{g}$  a number ( $n$ ) of sample values ( $v_i$ ) is picked (at random) from the probability density function  $f(y)$ . The estimate of  $\bar{g}$  is given by



$$\hat{g} = \frac{1}{n} \sum_{i=1}^n g(y_i). \quad (14)$$

The standard deviation of the estimate is given by S where

$$\hat{s}^2 = \frac{1}{(n-1)} \sum_{i=1}^n (g(y_i) - \hat{g})^2. \quad (15)$$

For large n the error involved in replacing (n-1) by n in this formula is of little consequence. The distribution

$$\frac{\hat{g} - \bar{g}}{\sqrt{\frac{\hat{s}^2}{n}}} \quad (16)$$

tends to a standardized normal distribution with increasing values of n. For the values of n considered in this paper (n > 1000) the distribution can be regarded as normal and confidence limits on the estimate of  $\bar{g}$  can be obtained on this basis. Since the standard deviation of  $\bar{g}$  is equal to  $S/\sqrt{n}$  the confidence limits can be reduced by increasing n. To reduce the standard deviation by a factor of ten the number of simulations trials must be increased one hundredfold. An alternative approach is to concentrate on reducing the size of  $\hat{s}^2$ . Such techniques are known as variance reduction techniques and several of them are described in Chapter 5 of Hammersley and Handscomb (1964). The thrust of these methods is to modify or distort the original problem in such a way as to improve the accuracy of the results obtained by crude Monte Carlo methods. One such approach is known as the control variate method.

The basic idea underlying this method is to replace the problem under consideration by a similar but simpler problem which has an analytic solution.

The solution of the simpler problem is used to increase the accuracy of the solution to the more complex problem. Suppose that the integral

$$\int g(y)h(y) dy = G \quad (16)$$

can be evaluated analytically where h is a probability density function. From eqs. (1) and (5) it is clear that

$$\bar{g} = G + \int g(y)[f(y) - h(y)] dy. \quad (17)$$

A revised estimate of  $\bar{g}$ ,  $\bar{g}^*$  can be obtained by evaluating the integral on the right-hand side of (6) by crude Monte Carlo methods. The function h is called the control variate. The gain in efficiency will be measured by the reduction in the variance of  $\bar{g}^*$  as compared to the variance of  $\bar{g}$ . The increase in efficiency will depend on the degree to which h mimics the behaviour of f. Thus, in selecting an appropriate control variate there are two (usually conflicting) requirements.

First  $h$  must give rise to an integral that is easy to evaluate. Second  $h$  must model the behaviour of  $f$ . In evaluating the integral in eq. (6) by crude Monte Carlo the same random number is used in the simulation trial to generate a value  $y$ , from  $s(y)$  and a value  $Y$ , from  $z(y)$ . For a given value of  $t$  let

$\bar{g} = \frac{1}{n} \sum_{i=1}^n s(u_i)f(v_i)$  and  $\bar{g} = \frac{1}{n} \sum_{i=1}^n S(Y_i)$  be the estimates obtained by crude Monte Carlo under these conditions. Then

$g^*$  is given by

$$g^* = G + \frac{1}{n} \sum_{i=1}^n (S(Y_i) - s(u_i)f(v_i)). \quad (7)$$

This is an unbiased estimate, and its variance is

$$\text{var}(g^*) = \text{var}(g) - 2 \text{COV}(g, \bar{g}).$$

This will be less than the variance of  $g$  as long as

or

This confirms the earlier observation that the efficiency gain is a function of the relationship between  $g$  and  $h$ . Furthermore eq. (8) furnishes a prescription for testing if a particular control variate will result in an efficiency gain. Whereas the control variate approach used a second estimate of the integral with a high positive correlation with the estimate of interest the antithetic variate approach exploits the existence of negative correlation between two estimates. In each problem there may be different methods of introducing an antithetic variate

## 6. Conclusion

Most of the products described above offer a downside protection and a capped return provided the investment is held to maturity. A large part of my research will be devoted to identifying the most suitable method to replicate the pricing of a given equity structured product. This research paper looks at the pricing of these structured products and find a fairly wide range across issuers, but nearly all involve a substantial premium over the cost of replication using exchange-traded options on the Eurex. The volume of the premium varies with moneyness, and there is a “life cycle” effect, as well, because the issuers make secondary markets in their securities and investors may sell them back prior to maturity.

By doing extensive research on equity linked structured product at this stage my thoughts on pricing such products could be done by buying a zero-coupon bond with the same maturity as that of the investment note. The balance amount of the remaining funds can be invested by identifying a ‘basket option’ which mirrors the basket of investments made by the Bank and hedging risks. Carrying the above idea further, this research to look at fair pricing of the zero-coupon bond and the basket option. Comparing this with the market price of the instrument I could draw conclusions based on how close the real market price of the instrument is with the recomputed price.

Bearing in mind the results presented in this paper, great care should be taken when judging quoted prices. Despite the very easy access to structured products, experienced investors should still consider buying or

selling options at derivatives exchanges with liquid trade. Nevertheless, it must be acknowledged that a useful “packaging” of single components could justify the implicitly demanded margins as compensation for the issuers’ structuring service for offering these products, including the commitment to provide liquid trading of the products. With the help of structured products, however, the issuers provide access to non-standard options positions, so that the observed premia can also be interpreted as commissions for this market extension. The market for structured products is still very attractive for issuers, due to the almost total absence of restrictions about underlying and contract conditions. Examples of recent developments in the German market for structured products are callable step-up bonds, bull, bear and condor bonds, kick start certificates, barrier, and two-asset products. Further research could concentrate on product classes apart from the ones considered in this paper, probably providing an even greater insight into the issuers’ pricing policies. Broader market research could consider the pricing stability over time. In addition, taking transactions costs into account, an investigation of concrete arbitrage strategies between the market for structured products and derivatives exchanges seems promising.

## 7. References

1. Baubonis, C., Gastineau, G.L., Purcell, D., 1993. The banker’s guide to equity-linked certificates of deposit. *The Journal of Derivatives* 1 (Winter), 87–95.
2. Chen, A.H., Kensinger, J.W., 1990. An analysis of market-index certificates of deposit. *Journal of Financial Services Research* 4 (2), 93–110.
3. Chen, K.C., Sears, R.S., 1990. Pricing the SPIN. *Financial Management* 19 (2, Summer), 36–47.
4. Das, S., 2000. *Structured Products and Hybrid Securities*, second ed. New York.
5. Despite Record \$50 Billion in 2005, Structured Products Remain ‘Wall Street’s Best Kept Secret’,” SPA Chairman’s Letter, February 2006, p. 1,2.
6. ‘Financial Instruments –The Structured Products Handbook’ Oesterreichische National bank  
<https://www.docin.com/p-78671211.html>
7. Pavel A. Stoimenov, Sascha Wilkens., 2004. Are structured products fairly priced? An analysis of the German market for equity-linked instruments. *Journal of Banking & Finance* 29 (2005) 2971–2993.  
<https://www.sciencedirect.com/science/article/abs/pii/S0378426604002511>
8. E. G. Haug, “The Complete Guide to Option Pricing Formulas”, 1997, McGraw-Hill,( p. 96,97)

9. Wasserfallen, W., Schenk, C., 1996. Portfolio insurance for the small investor in Switzerland. *The Journal of Derivatives* 3 (Spring), 37–43.
10. The Monte Carlo Method 1<sup>st</sup> Edition, The Method of statistical Trials, Yu.A. Shreider, 1966, (P67-72)
11. Levy, 1992 Levy, E. (1992). Pricing European average rate currency options. *Journal of International Money and Finance*, 11:474-491.  
[https://econpapers.repec.org/article/eeeejimfin/v\\_3a11\\_3ay\\_3a1992\\_3ai\\_3a5\\_3ap\\_3a474-491.htm](https://econpapers.repec.org/article/eeeejimfin/v_3a11_3ay_3a1992_3ai_3a5_3ap_3a474-491.htm)
12. Hammersley, J. M., D. C. Handscomb: Monte Carlo Methods. Methuen & Co., London, and John Wiley & Sons, New York, 1964. VII + 178 S., Preis: 25 s
13. Monte Carlo, Concepts, Algorithms, and Applications, Authors Fishman, George (1973-P.91,92)
14. [http://www.riskglossary.com/link/asian\\_option.htm](http://www.riskglossary.com/link/asian_option.htm)
15. Turnbull, S., & Wakeman, L. (1991). A Quick Algorithm for Pricing European Average Options. *Journal of Financial and Quantitative Analysis*, 26, 377-389.  
<https://doi.org/10.2307/2331213>

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

# **Biometric and reproductive characteristics of the King Tiger Plecos *Hypancistrus* sp. “L-333” (Siluriformes: Loricariidae) endemic to the lower Xingu River (Pará, Brasil)**

**Fabício Barros de Sousa**

Instituto Federal de Educação, Ciência e Tecnologia do Amazonas, Brazil

ORCID: <https://orcid.org/0000-0001-9834-9005>

Email: [fabriciobsousa@gmail.com](mailto:fabriciobsousa@gmail.com)

**Hélio Beltrão**

ORCID: <https://orcid.org/0000-0002-5414-5518>

Universidade Federal do Amazonas, Brazil

Email: [heliidosanjos@gmail.com](mailto:heliidosanjos@gmail.com)

**Rodrigo Yudi Fujimoto**

ORCID: <https://orcid.org/0000-0002-5039-4445>

Empresa Brasileira de Pesquisa Agropecuária, Brazil

E-mail: [rodrigo.fujimoto@embrapa.br](mailto:rodrigo.fujimoto@embrapa.br)

**Raimundo Aderson Lobão de Souza**

ORCID: <https://orcid.org/0000-0003-0424-5008>

Universidade Federal Rural da Amazônia, Brazil

E-mail: [adersonlobao@globo.com](mailto:adersonlobao@globo.com)

**Severino Adriano de Oliveira Lima**

ORCID: <https://orcid.org/0000-0001-6495-5453>

Universidade Federal de Rondônia, Brazil

E-mail: [limasao@unir.br](mailto:limasao@unir.br)

**Raniere Garcez Costa de Sousa**

ORCID: <https://orcid.org/0000-0002-5620-389X>

Universidade Federal de Rondônia, Brazil

E-mail: [ranieregarcez@unir.br](mailto:ranieregarcez@unir.br)

## **Abstract**

*This research analyzed the biometrics and reproductive characteristics of a group of Hypancistrus sp. L-333 (King Tiger Plecos) in order to gather biological information and aid the rearing of the species in*

captivity, thus supporting its natural conservation. This species has a natural distribution that is restricted to the lower Xingu River, and is currently threatened by the hydroelectric projects in the region. The acquired specimens were measured, weighed and classified according to sex based on morphometric characteristics (evidence of secondary sexual characteristics) that were later confirmed by dissection. A total of 32 individuals, 16 males and 16 females were identified. Although the length-weight ratio did not present significant differences, the results revealed that the species has secondary sexual dimorphism. The odontodes were more developed in the mid-lateral region of the body, post-dorsal region, caudal peduncle and in the first ray (ossified) of the pectoral fin in males. Histological analyses of the gonads confirmed that all of the fish were adult individuals. The diameter of the oocytes ranged from 0.14 to 2.0 mm, presented three distinct modes, and were synchronous in more than two groups, which evidences batch spawning. Fecundity was low, between 35 and 54 oocytes in the largest batch. This information is novel and important for the identification of reproductive groups, and is aimed at breeding in captivity so that these resources can be exploited in a sustainable way, without harming the already threatened natural stocks.

**Keywords:** King Tiger Plecos, *Hypancistrus-zebra*, Reproduction, Conservation, Xingu River.

## 1. Introduction

Ornamental fish are widely taken from the rivers of clear, muddy and black waters in the different Brazilian states that make up the Amazon basin (Anjos et al., 2009), and the state of Pará is the main exporter of ornamental fish. It is in the state of Para that the species of the family Loricariidae stand out. These are locally known as acarís or bodós and internationally known as “Plecos” or by the L-codes (Seidel, 1996; Prang, 2007). Among the several species exported are the individuals of the genus *Hypancistrus*, which belong to the tribe Ancistrini and the subfamily Hypostominae. *Hypancistrus* is distinguished from the other genera of this subfamily by having the presence of teeth in greater number along the premaxilla and in the maxilla (Armbruster, 2004; Armbruster et al., 2007).

Currently, eight species of the family Loricariidae are formally described; *Hypancistrus zebra* Isbrücker and Nijssen (1991), which is endemic to the stretch of the Xingu River known as Volta Grande, Pará state, Brazil, *H. inspector* Armbruster (2002), which occurs in the regions of the upper Orinoco River and the Negro River, between Venezuela and Brazil; the species of *Hypancistrus contradens*, *H. debilitata*, *H. furunculus*, and *H. lunaorum* Armbruster et al. (2007) are distributed in the Orinoco River, Venezuela, and *H. margaritatus* and *H. phantasma* Tan and Armbruster (2016) from the Negro River, Amazonas state, Brazil.

Six other morphospecies of *Hypancistrus* (with distribution restricted to the Xingu River) are in the process of taxonomic confirmation and description, and are part of the list of species and morphospecies that allowed to be exported for ornamental purposes (Interministerial Normative Instruction n° 01 of the Ministry of Fisheries and Aquaculture-MPA and the Ministry of the environment - MMA of January 3<sup>rd</sup>, 2012, which establishes norms, criteria and standards for the exploitation of native or exotic fish from inland waters for ornamental or aquaristic purposes). Among these morphospecies that are organized with



the L-code, we highlight *Hypancistrus* sp. L-004, L-066, L-136, L-260, L-262 and L-333.

*Hypancistrus* sp. L-333, known locally as “Acari pão” and internationally with the code-L or as “King Tiger Plecos”, is endemic to rocky outcrops in the lower Xingu River, downstream of Cachoeira Grande, in the state of Pará, Brazil (Camargo et al., 2004). It is abundant in this region, although specimens have already been released in places upstream of Cachoeira Grande, as a result of the disposal of ornamental fish exporting companies in the city of Altamira-PA (Anatole et al., 2008). This morphospecies, in conjunction with the other Loricarideos, are in danger of local extinction, which may happen before they are known and identified, mainly as a result of the loss of their habitats resulting from the construction of the hydroelectric dam of Belo Monte (Buckup and Santos, 2010; Khatri, 2013; Haglund, 2014), which interrupts and alters the ecology of vast stretches of the Xingu river and makes the environment unsuitable for this and other species that depend on the lotic environment of the rapids and the periphyton for their survival (Haglund, 2014).

Due to its great ornamental value, the King Tiger Plecos is highly sought after by the international market, mainly in Europe, Asia and the United States. Although its capture has been allowed since 2012 (MPA and MMA, 2012), the demand seems to be higher than the available stock, which is found in the lower Xingu River.

Studies are being conducted to find ways to reproduce *Hypancistrus* sp. L-333 in captivity. However, these initiatives are usually carried out by exportation companies operating in the city of Belém, Pará state (personal observation by F. Souza), or in other countries, such as Singapore, Germany and New Zealand (Seidel, 2005; Mick, 2005; Stevens, 2014a; 2014b). Nevertheless, despite initiatives to reproduce *Hypancistrus* sp. L-333, the techniques currently used have not yet been fully mastered, which, once mastered, would minimize the fishing pressure on natural stocks.

As such, primary information for the development of captive fish reproduction techniques is still limited especially that regarding phenotypic character, such as sex differentiation, specimen size, coloration and secondary sexual dimorphism (Godinho et al., 2007), and the main external morphological characteristics, such as the presence of urogenital papilla, modifications of pelvic and anal fins, body dichromatism, behavioral change, presence or hypertrophy of odontodes, among others (Moreira et al., 2001; Py-Daniel and Cox-Fernandes, 2005; Saurabah et al., 2013). These differentiations contribute to the attraction of animals that form groups or couples for reproductive purposes, and also aid in genetic improvement, which facilitates the choice of desired characteristics to raise the quality and commercial value of the offspring (Cnaani and Levavi-Sivan, 2009; Saurabah et al., 2013; Martínez et al., 2014).

Unfortunately, there is lack of studies on the species of Loricariidae, mainly regarding the genus *Hypancistrus*, which have not yet been formally described, and which are already strongly threatened with extinction, especially by the anthropogenic actions in the Xingu River region (its endemic region). Thus, the objective of this research was verify the existence of phenotypic differences that can be used for the differentiation between male and female individuals of *Hypancistrus* sp. “L-333” and, in this way, contribute to the identification and formation of couples in breeding periods, thereby assisting in the maintenance and development in captivity. In addition, during the study, useful information can be gathered for the conservation of the species in its natural environment.

## 2. Methods

### 2.1 Study area

The region of the Xingu River between the locations of Vitória do Xingu (2° 53' 5.11" S, 52° 0' 45.24" W) and Porto de Moz (1° 45' 6.29" S, 52° 14' 14.53" W), both in the state of Pará, is a distribution site of the target species of the study (Figure 1).

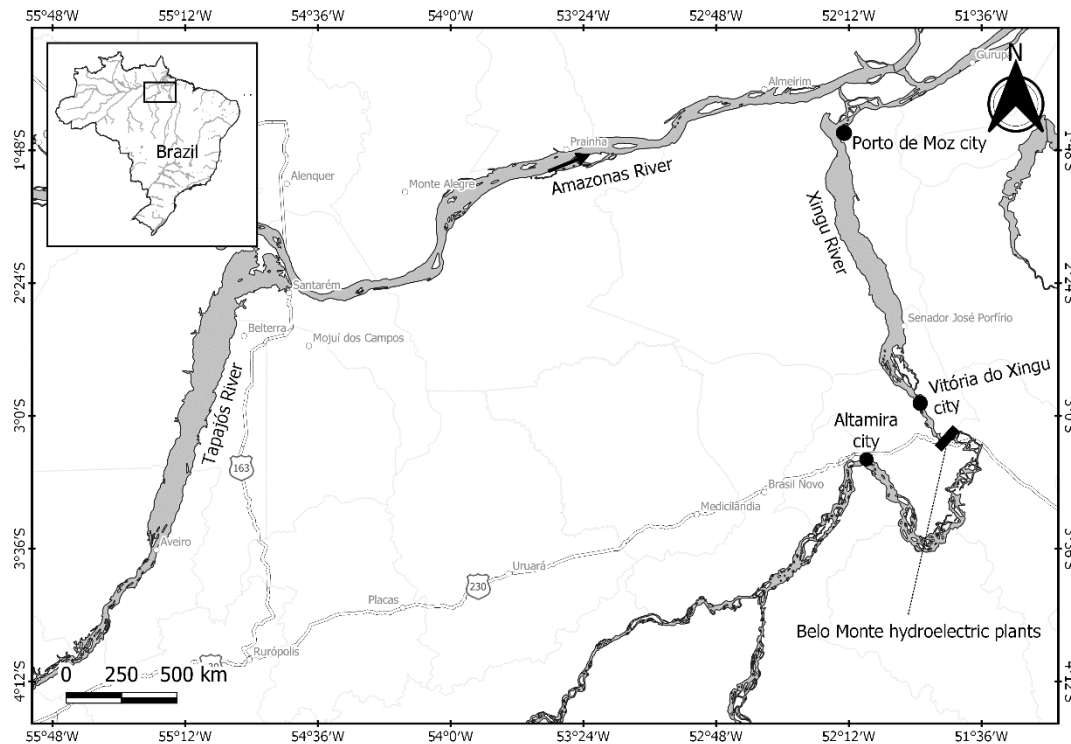


Figure 1. Map of Brazil showing details of the geographical location of the region of the lower Xingu River (area of distribution of the species *Hypancistrus* sp. “L-333”), downstream of the Belo Monte hydroelectric dam.

### 2.2 Sample collection and preparation

In total, 32 specimens of the King Tiger Plecos (*Hypancistrus* sp. “L-333”) were acquired from catches made by fishermen in the month of July 2014, under the zoological material collection license number 7119-1 (Authorization and Information System in Biodiversity – SISBIO/ICMBio). The individuals were transported to Belém, Pará state in accordance with the norms and criteria established in the Normative Instruction MPA and MMA N° 1 of 03/01/2012 (MPA and MMA, 2012) and MPA N° 21 of 11/09/2014 (MPA, 2014).

When the specimens arrived, they were quarantined for observation and then acclimatized in 110 liter aquariums (70 cm long x 45 cm deep x 35 cm wide) with a water recirculation system and constant temperature control, which was maintained around 28 °C (±0.7) and under natural lighting (12 h of light/12 h of darkness). The fish were fed with commercial feed in tablets, which was exclusive for Plecos or ornamental acari in general, and offered twice a day (9 h and 15 h), and corresponded to 2% of the biomass of each group.

After the quarantine period (30 days), the morphological analysis of the specimens to verify the existence of secondary sexual differences was performed. For this purpose, the fish were anesthetized with Tricaine-

S<sup>®</sup> (Ms 222 - tricaine methanesulfonate, Western Chemical Inc., USA), at a concentration of 100 mg per liter of water, which aided in handling. For the morphological differentiation criteria between the sexes, evidence of secondary sexual characteristics was considered, as described by Seidel (1996), Roman (2011), Py-Daniel and Cox-Fernandes (2005) for species belonging to the family *Loricariidae* of the Amazon.

For males, the characteristics included the predominance of long spines or odontodes in the mid-lateral region of the body, in the pectoral and intraopercular fin regions, as well as having larger fins, a more elongated body and a triangular head. For females, the presence of shorter spines or odontodes, a more robust body, shorter fins and a more rounded head were observed. The total length (TL) in cm and the total weight (TW) in grams were also recorded for each specimen.

After the procedures and obtention of biometric data, the specimens were euthanized with a lethal dose of anesthetic, as recommended by the American Veterinary Medical Association (AVMA, 2013). The preparations of the histological slides were performed using the techniques described by Prophet et al. (1995). Fragments of the gonads (ovaries and testicles) measuring 0.5 cm were immersed in Bouin fixative solution (saturated aqueous solution of picric acid, 36-40% formalin and glacial acetic acid) for 24 hours and submitted to the paraffin inclusion technique. The 5 µm thick gonad sections were stained in hematoxylin/eosin (HE) for observation and documentation using a Zeiss<sup>®</sup> PRIMO STAR<sup>®</sup> trinocular microscope with a Zeiss<sup>®</sup> camera. The histological procedures for the gonads were performed at the Federal Rural University of Amazonia - UFRA.

### 2.3 Analysis of biometric and histological data

The biometric information of the specimens were tabulated and submitted first to descriptive analysis to obtain the mean values and standard deviations of the weights and lengths of females and males. The growth models considered were of the type:  $TW = aTL^b$ , where TW is the total weight (g), TL is the total length (cm),  $a$  is a constant and  $b$  is the allometric coefficient (slope). In this study, the parameters  $a$  and  $b$  were determined by linear regression:  $\log TW = \log a + b \cdot \log TL$ . The 95% confidence interval (CI) was determined for parameters  $a$  and  $b$ . The Pearson correlation coefficient  $r$ -squared ( $r^2$ ) was estimated. The allometric condition factor ( $K_{rel}$ ) was calculated according to the equation:  $K_{rel} = TW/(aTL^b)$  (Le Cren, 1951; Froese, 2006). The differences between females and males was obtained with a covariance analysis (ANCOVA), by analyzing significant differences ( $\alpha = 0.05$ ) between the slopes. All statistical analyses were performed in the R 4.0.0 program (R core team, 2020).

In the histological analysis, morphometric observations were performed and subsequently, microscopic analyses of the gonads (ovaries and testes) to confirm the visually observed phenotypic characteristics, according to the classification established by Vazzoler (1996), which is defined as:

Stage I: immature individuals (females with large amount of oogonia and previtellogenic oocytes; males with large amount of spermatogonia);

Stage II: maturing individuals (females with oocytes at the beginning of endogenous vitellogenesis; males with all types of cells: spermatogonia, spermatids, spermatocyte and few spermatozoa);

Stage III: mature (females with larger oocytes in protein vitellogenesis, with cytoplasm filled with globules of vitello and a membrane with two layers, the chorion and the theca; males with large amount of sperm in the lumen);

Stage IV: exhausted or spawned (females with few oocytes and large amount of empty follicles and cells in atresia; males with totally empty lumen).

### 3. Results

Of the 32 specimens analyzed, 16 specimens were classified as males and 16 as females (Table 1). For males, the minimum and maximum values of total length were 10.1 and 13.7 cm (mean of 11.86 cm  $\pm$  0.85) and for females the lengths were 8.0 and 10.4 cm (mean of 9.11 cm  $\pm$  0.78). The minimum and maximum weight of males was 19.5 and 38 g (mean 27.01 g  $\pm$  5.31) and for females weights were 8.9 and 16.0 g (mean 13.10 g  $\pm$  3.57). Length – weight relationships for the separate sexes and both together had significant coefficients of determination that were above 0.91. There was no significant difference in the slope between males and females (ANCOVA;  $p = 0.076$ ). The allometric condition factor ( $K_{rel}$ ) was slightly higher for females.

Table 1. Length – weight relationship parameters estimated for females, males and the total number of *Hypancistrus* sp. “L-333” in the lower Xingu River region, Pará state, Brazil. N – number of individuals;

TL – total length; TW – total weight; LW – length – weight; CI – confidence interval;  $r^2$ -Pearson  $r$  – squared for log – log regression, SD – standard deviation;  $K_{rel}$  – allometric condition factor; a – intercept; b – slope.

Sex	N	TL		TW		Length-weight relationship (LWR) parameters			
		Min	Max	Min	Max	a (95% CI)	b (95% CI)	$r^2$ (95 % CI)	$K_{rel}$ (SD)
Female	16	8.0	10.4	8.9	22.5	0.034 (0.008 – 0.142)	2.685 (2.038 – 3.332)	0.922 (0.785 – 0.973)	1.004 (0.099)
Male	16	10.1	13.7	19.5	38.0	0.061 (0.014 – 0.274)	2.458 (1.851 – 3.065)	0.918 (0.776 – 0.972)	1.003 (0.078)
Total	32	8.0	13.7	8.9	38.0	0.031 (0.019 – 0.051)	2.730 (2.521 – 2.939)	0.971 (0.942 – 0.986)	1.004 (0.089)

The growth curve and the result of the model with the two aggregate sexes are presented in Figure 2, and in most cases the males were observed at the top of the curve, while the females were at the bottom.

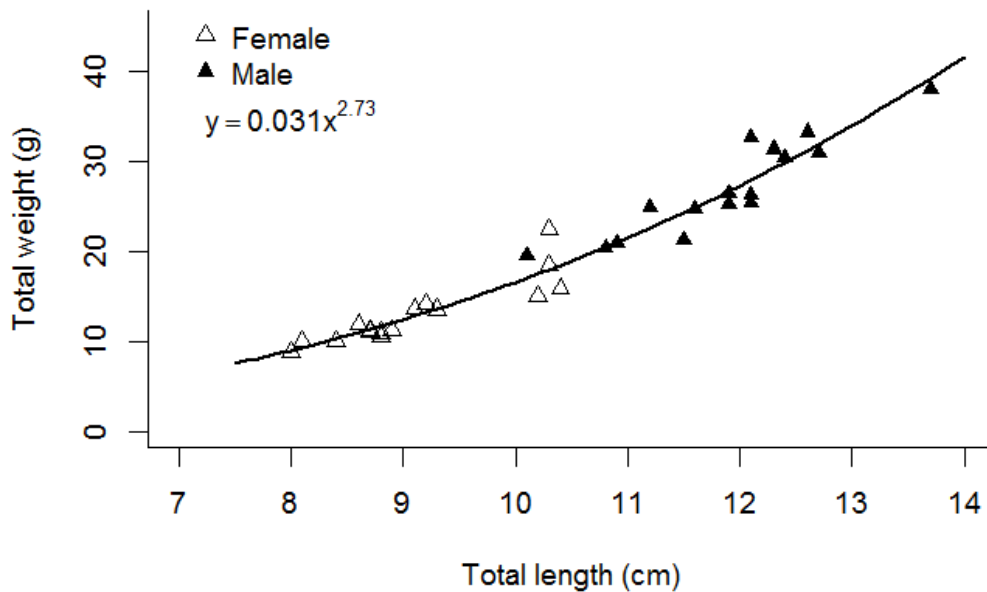


Figure 2. Length – weight relationship of all *Hypancistrus* sp. "L-333" individuals caught.

The standard coloration of males and females were similar, and they presented a pattern of black bands on a white background or light yellow background, which were observed along the entire length of the body of the fish. These bands are arranged randomly, and do not follow a pattern. They are usually arranged in six dark bands present in the dorsal fin, five to six in the pectoral fin and four to five in the pelvic fin. Six to eight dark vertical bars are also present on the caudal fin (Figure 3). In both sexes, the ventral part of the body presented a clear to light gray surface from the mouth to the urogenital region.

Characteristics of secondary sexual dimorphisms were apparent in all captured specimens, and correspond to the class of total length amplitude between 8.0 cm and 13.7 cm. Adult males have a slightly wider head than the females, with a more pronounced elevation of the supraoccipital process. There is a presence of longer odontodes in the interopercular region and in the entire distal extension of the first ray (ossified) of the pectoral fin (Figure 3A). The adipose fin of these individuals presents developed odontodes, which are more easily seen if observed horizontally (Figure 3). Males also have longer and more pronounced odontodes in the mid-lateral region of the body, especially in the post-dorsal area and caudal peduncle. These present an epidermis (bone plates with odontodes) that is dry and rough. On the other hand, in females, the odontodes are poorly developed throughout the body, presenting a less dry or rough epidermis. In males, the first rays of the caudal fin (both upper and lower) are more elongated and in the form of a small filament, while in females these caudal rays are shorter (Figure 3B).



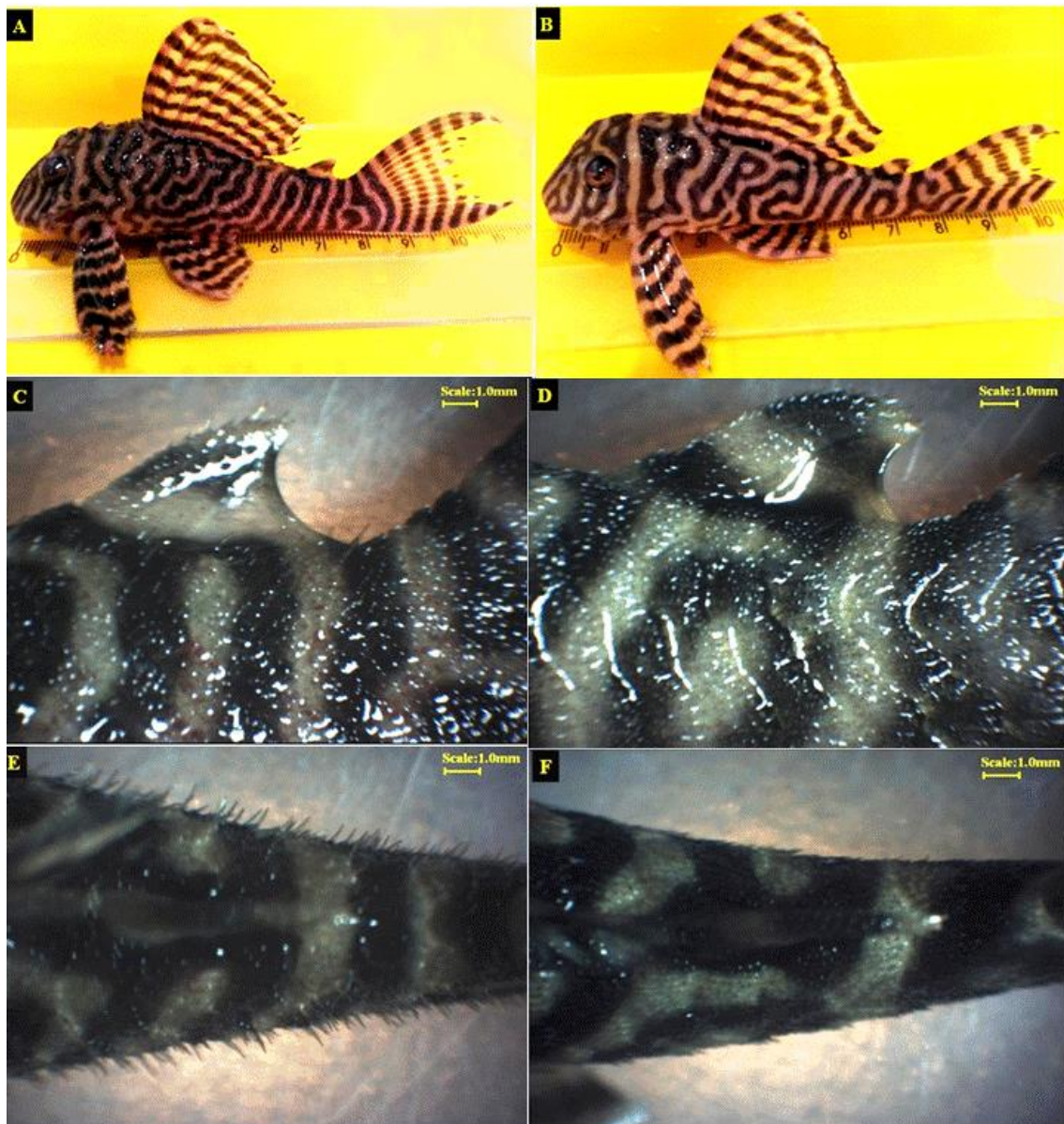


Figure 3. Male (A) and female (B) specimens of *Hypancistrus* sp. "L-333"; caudal peduncle of male (C) and female (D) observed horizontally and post dorsal region of male (E) and female (F) observed from above.

Regarding the morphology of the gonads in male individuals, the testes of *Hypancistrus* sp. L-333 are even, dorso-ventral flattened organs and are located in the posterior ventral cavity of the body, just above the intestine. They are a lobular structure consisting of seminiferous tubules, which join in the terminal portion near the urogenital opening. For female specimens, the ovaries are saculiform with opaque yellow coloration, and are covered externally by a thin peritoneum, consisting of dense, connective tissue. This membrane is directed towards the inside of the ovary and forms structures called ovule lamellae, in which the oocytes at different stages of development are located.

All male subjects analyzed were in the process of maturation (Stage II) or were mature (Stage III). Through microscopic observation of the testicles, it was possible to identify, in the seminiferous tubules, a few spermatogonias on the periphery of the tubules, exhibiting rounded cells with well-defined nucleus, which were the largest of the spermatogenic lineage (Figure 4A). It was also possible to observe spermatid cells,



which are smaller than spermatogonias and are located on the margins of the seminiferous tubules (Figure 4C). In addition, most of the males analyzed had testicles with the lumen completely occupied by spermatozoa, which are smaller cells with a highly condensed nucleus and are found in the central part of the seminiferous tubule (Figure 4).

All the females analyzed were in maturation (Stage II) or were mature (Stage III) and presented oocytes in different stages of development, with diameters ranging from 0.14 to 2.0 mm. The oocytes presented three distinct diameters, and were synchronous in more than two groups, evidencing spawning of the batch type. Fecundity was low, being between 35 and 54 oocytes in the largest batch ( $n = 5$ ), however the number of oocytes in the lower diameters was not counted.

In microscopic observations of the ovaries, it was possible to identify three main types of oocyte cells. The previtellogenic oocytes (PVG) were characterized by having small size (0.14 -0.20 mm) and homogeneous basophilic cytoplasm, usually a central or sub-central nucleolus. Oocytes were also found in the gonads at the beginning of vitellogenesis (IVG), with diameters of 0.38-0.74 mm, which were easily distinguished from PVG oocytes by the presence of lipid globules in the peripheral cytoplasm (endogenous vitellogenesis), and cortical alveoli that presented visible nuclei that were located in the central position (Figure 4). A large amount of oocytes were also found in protein vitellogenesis (VGP), with a diameter of 1.7 to 2.0 mm, and these presented larger oocytes, in which it was possible to observe two membrane structures: the chorion (zona radiata) and the theca (granular layer), which also presented cytoplasm that was completely filled with globules of vitello (Figure 4). No empty or postovulatory follicles were found, which would indicate specimens with gonads in Stage IV (spawned). These structures, which are visible only after spawning, are ovulatory lamellae that surround the oocytes. In addition, no cells were found in atresia (which are generally oocytes, unspawned and remain in the ovaries, have an irregular appearance, and have lost their rounded configuration) (Figure 4).

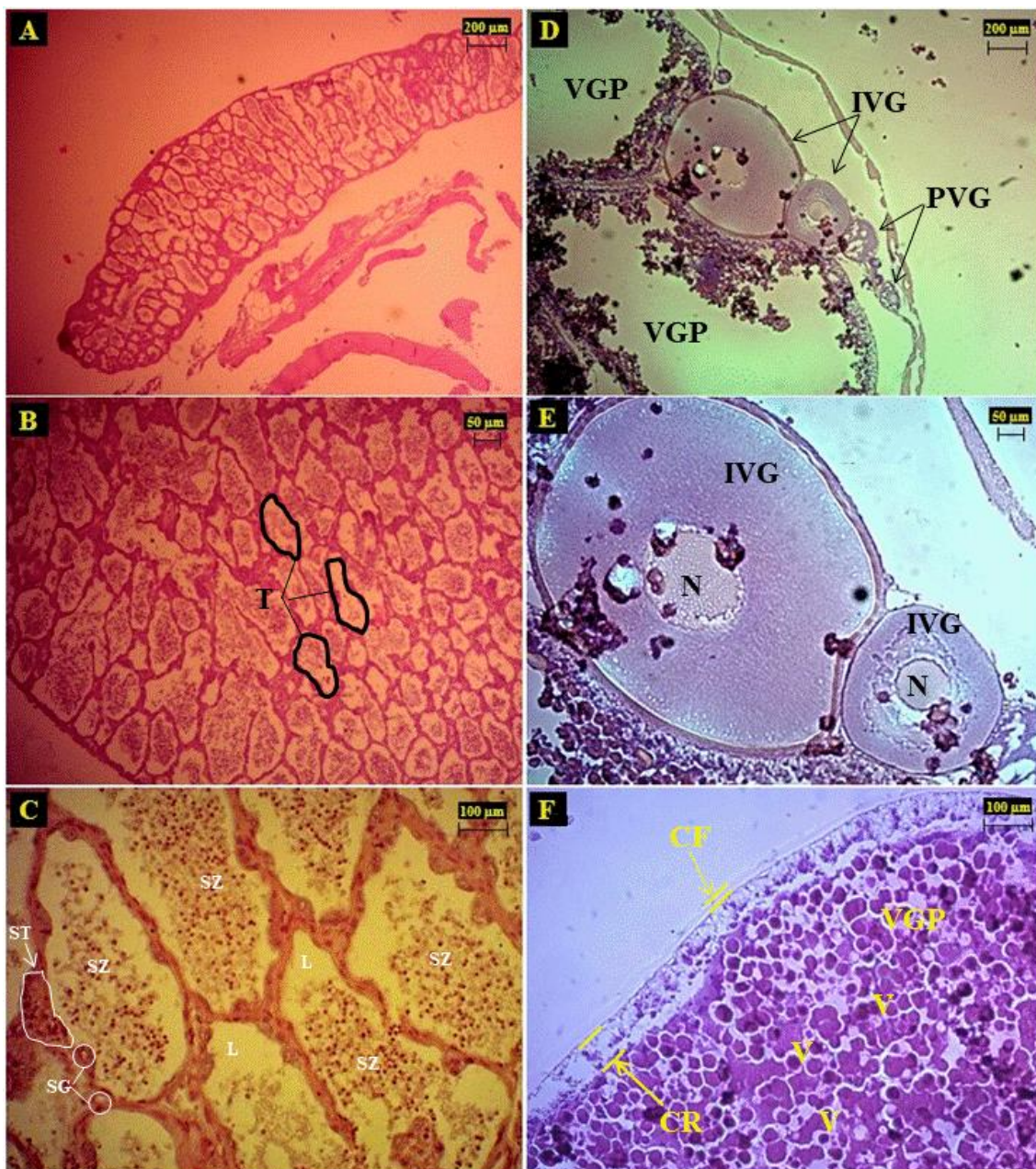


Figure 4. Testicular and oocyte photomicrography of *Hypancistrus* sp. L-333. (A) transverse aspect of the flattened form of the testicle (40x magnification); (B) presence of a large amount of seminiferous tubules (T) as exemplified in the image (100x); (C) detail of seminiferous tubules with the presence of different cell types: spermatogonia (SG), spermatids (ST) and large amount of spermatozoa (SZ) scattered in the lumen (L) (400x); (D) ovary fragment with the presence of previtellogenic oocytes (PVG), beginning of endogenous vitellogenesis (IVG) and oocytes in protein vitellogenesis (VGP) (40x); (E) detail of oocytes at the beginning of vitellogenesis (IVG) with diameters between 0.38 to 0.74 mm and cytoplasm filled with vitello – the nucleus is still visible and located in a central position (N) (100x); and (F) details of mature oocyte in protein vitellogenesis (VGP) in which it is possible to observe large amount of globules of vitello (V) and two membrane structures, the chorion or corona radiata (CR) and follicular cells (CF) (400x) with hematoxylin-eosin (HE) staining.

#### 4. Discussion

All values for parameter B of the length – weight relationship estimates were within the expected limits (2.5 to 3.5), as suggested by Froese (2006). For the condition factor, which has been widely used to indicate changes in the well-being of fish, since it reflects the physiological condition, food availability and adaptation of fish the seasonal fluctuations that occur in the environment (Barbieri and Verani, 1987; Chellappa et al., 1995), *Hypancistrus* sp. L-333 showed no significant differences in the condition factor between the sexes. Food availability seems to have been sufficient to provide good trophic conditions and ensure the necessary energy supply to the species for the reproductive period (at least for the observed sample period).

Regarding body size, the males of *Hypancistrus* sp. L-333 were generally larger than females with classes of lengths greater than 11 cm (TL). However, the slope between the sexes was not distinct. The larger size of the male may have occurred as a result of older individuals having been captured compared to the females or be a biological attribute of the species, since it confers a competitive advantage for reproduction since the males of the family Loricariidae present parental care (Tos et al., 1997; Suzuki et al., 2000).

In males, odontodes developed along the body were also found, and was a striking feature between the sexes and, mainly in the breeding season, one that can serve in the selection of individuals. Among several genera of Loricariinae, a subfamily of Loricariidae, although there are different forms of secondary sexual dimorphism, the main ones are related to the pronounced development of odontodes in the pectoral, pelvic, and anal regions, as well as in the snout, head bones and in the caudal peduncle region (Covain and Fisch-Muller, 2007). In the present research, these characteristics were also highlighted in the studied species.

In reproductive season, the secondary sexual dimorphism, which was quite evident between the sexes of *Hypancistrus* sp. L-333, can be a useful tool in the selection and formation of couples for reproduction in captivity. The sister species, *Hypancistrus zebra*, does not present obvious sexual dimorphisms or dichromatism, which hinders the identification of the sexes (Roman, 2011). This is also the case for *H. furunculus*, which has distribution restricted to the Orinoco River, Venezuela (Armbruster et al., 2007). However, in a study conducted in the Orinoco River, sexual dimorphism was observed for the species *H. contradens*, *H. debilitera* and *H. lunaorum*, and nuptial males have slightly hypertrophied odontodes on the lateral plates of the head and in the caudal region (the size of the odontodes subsequently increases in the second half of the body).

Secondary sexual dimorphisms in fish are external characteristics generated by the sexual instinct that are usually easily visible and, as such, are a useful tool for gender classification among individuals. These sexual differences, depending on the species, can be observed in the morphology of the body; more specifically, in the urogenital region, modifications in the pelvic and anal fins, more pronounced coloration in one of the sexes, protrusions in the cephalic region, behavioral differences, among others (Rotta, 2004; Py-Daniel and Cox-Fernandes, 2005; Anjos and Anjos, 2006; Godinho, 2007; Godinho et al., 2010).

Several species of the family Loricariidae have structures that may indicate characteristics of secondary sexual dimorphism (Py-Daniel and Cox-Fernandes, 2005). However, many authors mention that the presence of odontodes in different parts of the body is the most striking characteristic of secondary sexual dimorphism that exist in species of Loricariidae (Rodríguez and Miquelarena, 2005; Covain and Fisch-



Muller, 2007; Pereira et al., 2007), and can be found in large species, such as the *Panaque schaeferi* that can reach a standard length of 60 cm (Lujan et al., 2010) as well as in miniature species such as *Nannoplecostomus eleonora*, which reaches a total length of close to 3 cm (Ribeiro et al., 2012).

Odontodes can be found in both males and females of several species of the family Loricariidae (Py-Daniel and Cox-Fernandes, 2005), however, some authors mention that sexing should be done using the presence of odontodes to distinguish males and females within this family (Rodríguez and Miquelarena, 2005; Covain and Fisch-Muller, 2007; Pereira et al., 2007). Male and female *Pareiorhaphis nasuta*, for example, have odontodes in the pectoral fin region, however, these odontodes are larger in adult males and smaller in juvenile males and females, thus indicating a form of secondary sexual dimorphism (Pereira et al., 2007). A similar pattern occurs in the species *Dolichancistrus atratoensis*, *D. carnegiei*, *D. cobrensis* and *D. fuesslii*, which have odontodes in both sexes, and these structures are noticeably more developed in males compared to females (Ballen and Vari, 2012). These characteristics were also observed in *Hypancistrus* sp. L-333, in individuals above 8.0 cm (TL).

In the species of the genus *Rineloricaria*, the odontodes are also more pronounced in males during the period of reproductive activity, particularly on the the sides of the head, in the opercular region, on the dorsal surface of the pectoral fins, and in the pre-dorsal and the caudal peduncle regions (Rodríguez and Miquelarena, 2005; Covain and Fisch-Muller, 2007). This is clearly visible in the species of *Rineloricaria osvaldoi*, especially in relation to immature males and females (Fichberg and Chamon, 2008). However, there are also some species of acari of the Xingu and Tapajós Rivers in the state of Pará that present hypertrophy of the odontodes in males in reproductive age, as is the case of *Baryancistrus chrysolomus* (Py-Daniel et al., 2011) and *Peckoltia feldbergae* (Oliveira et al., 2012).

In addition to odontodes, the histology of the reproductive organs is an important tool for confirming the sex of the specimens and determining the stage of gonadal maturation, and provides direct visualization of the reproductive structures of females (oogonia, oocytes, etc.) and males (spermatogonia, spermatids, etc.) and has greater accuracy, regardless of their degree of maturation (Vazzoler, 1996; Solis-Murgas et al., 2011; Andrade et al., 2015). The present research shows that the individuals of the analyzed species captured in the flood period (July) were in the process of gonadal development. However, it is important to point out that the reproductive period of the species was not the object of the study, since the samples came from a single month of collection.

Although there were no differences in the pattern of coloration between males and females, secondary sexual dissimilarities (odontodes developed along the body and in the distal part of the first ossified ray of the pectoral fin) that are essential in the differentiation of males and females were verified. The ease in the differentiation of the sexes of *Hypancistrus* sp. L-333 in the reproductive season may present advantages for the cultivation of this species in captivity, and thus minimize the fishing pressure of these individuals in their natural environment, since this species has not yet been formally described, despite being considered abundant in the recent past (Anatole et al., 2008). On the other hand, the natural environment of this species is threatened due to the Belo Monte hydroelectric dam on the Xingu River, which affects precisely the area of the geographical distribution of the species. In this region, the flow of the Xingu River has lost its hydrological and seasonal characteristics, influencing the decrease in flow and depth (Haglund, 2014). These factors put at imminent risk the fish populations that inhabit these environments, especially

the populations of small Loricariidae such as *Hypancistrus* sp. L-333.

The impacts of the Xingu River dam are already reflecting in the congener species *H. zebra*, which now has a diminished distribution in the Volta Grande stretch of the Xingu River. Although since 2004 it is forbidden to catch *H. zebra* (Normative Instruction N°. 5, May 21<sup>st</sup>, 2004), this sister species is the most sought after among the Loricariidae in aquarism around the world, and is currently critically endangered, due to the loss of its natural habitat and illegal fishing. This can lead, in a short period of time, to the decline and or extinction of the natural population of this species (Roman, 2011).

Even though *H. zebra* is recognized by the federal government as being critically endangered, and is prohibited for exploitation (Ordinance N°. 445, December 17<sup>th</sup>, 2014) and is listed in the Red Book of Endangered Species of Brazil (ICMBio, 2016), specimens of this species are smuggled to other countries, such as Peru and Colombia. According to Anatole et al. (2008), there are estimates that annually about 250,000 specimens of this species are smuggled from the Xingu River region, and are sold in pet shops in Europe and the United States, and have a market value of around US\$ 400 dollars (Pedersen, 2016).

The results presented here can serve as basic information to aid the cultivation of *Hypancistrus* sp. L-333 in captivity, and thus minimize the impacts on the natural stocks of this species, which is threatened by the existence of the hydroelectric dam on the Xingu River. Even if this species presents low fecundity, due to the small amount of oocytes in complete vitellogenesis (between 35-54 oocytes), there are indications that it performs more than one spawning throughout its reproductive period.

The present study details an imminent reproduction phase of the species *Hypancistrus* sp. L-333 in nature, due to the larger batch of oocyte found in the females, which were in the phase of complete vitellogenesis, and a large amount of spermatozoa in the males, which characterizes preparation for the reproductive process of the species in its natural habitat. However, only the continuity of monitoring of the reproduction of the species after the full operation of the Belo Monte hydroelectric power plant, can elucidate the gaps in information on the permanence, or not, of this and other species of Loricariidae that are endemic to the Xingu River region, in the area of influence of the project, so that sustainability indicators can be analyzed for the best management of the natural stocks of King Tiger Plecos.

## 5. Conclusion

In the present study it was possible to determine the sex of individuals of *Hypancistrus* sp. “L-333” by using the phenotypic characteristics (confirmed by histological analysis) that exist between males and females of the King Tiger Plecos and indicate which groups of reproductive individuals can be identified through external characteristics. As such, males and females of the King Tiger Plecos can be selected for their most striking reproductive characteristics (more developed odontodes in the post-dorsal region of the body and the first ossified ray of the pectoral fin with well-developed odontodes in males), and these characteristics can be applied in obtaining groups suitable for reproduction in captivity.

## 6. Acknowledgement

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001. Also, the authors would like to thank, UFRA, Projeto Arapaima Imp.

e Exp. de Aquicultura LTDA and Professor Dr. Edilson Rodrigues Matos of the “Carlos Azevedo” Research Laboratory (LPCA-UFRA).

## 7. References

- A. Cnaani, and B. Levavi-Sivan, Sexual development in fish, practical applications for aquaculture, Sexual Development in Aquaculture, 3, 2009, pp.164-175.
- A. Mick, L333 Pleco - The Tank and Proper Care & Forum: Brief Description. Aqua-Fish.net. 2005. Retrieved from <https://en.aqua-fish.net/articles/breeding-feeding-care-l333-pleco-fish>
- A.C. Ribeiro, F.C.T. Lima, and E.H.L. Pereira, A new genus and species of a minute suckermouth armored catfish (Siluriformes: Loricariidae) from the Rio Tocantins Drainage, Central Brazil: The smallest known Loricariid Catfish, Copeia, 4, 2012, pp.637-647.
- A.E.A.M. Vazzoler, Biologia da reprodução de peixes teleósteos: teoria e prática. Eduem, 1996.
- A.L. Godinho, I.R. Lamas, and H.P. Godinho, Reproductive Ecology of Brazilian freshwater fishes. Environmental Biology of fish, 87, 2010, pp.143-162.
- A.P.O. Roman, Biologia Reprodutiva e Dinâmica Populacional de *Hypancistrus zebra* Isbrücker & Nijssen, 1991 (Siluriformes, Loricariidae), no rio Xingu, Amazônia Brasileira. Dissertação (Mestrado) Universidade Federal do Pará-UFPA, Belém, 2011.
- A.V.M.A. American Veterinary Medical Association: Guidelines for the Euthanasia of Animals, 2013, Retrieved from <https://www.avma.org/KB/Policies.pdf>
- C.D. Tos, A.A. Agostinho, and H.I. Suzuki, Population Structure and Reproductive Biology of *Loricariichthys platymetopon* (Siluriformes, Pisces) in the Upper River Paraná. Brazilian Archives of Biology and Technology, 40 (4), 1997, pp.793-807.
- D. Stevens, Fish breeding: Breeding plecos in New Zeland. Aquarium World Magazine, 60 (3), 2014a, pp.16-19.
- D. Stevens, Fish breeding: Keeping and breeding King Tigers. Aquarium World Magazine, 60 (3), 2014b, pp.20-23.
- E.B. Prophet, B. Milis, J.B. Arrington, and L.H. Sobin, Metodos histotecnologicos. Instituto de Patologia de las Fuerzas Armadas de los Estados Unidos de America (AFIP), 1995.
- E.D. Le Cren, The length-weight relationship and seasonal cycle in gonadal weight and condition in the perch (*Perca fluviatilis*), Journal of Animal Ecology, 20 (2), 1951, pp.201-219.
- E.H.L. Pereira, F. Vieira, and R.E. Reais, A new species of sexually dimorphic Pareiorhaphis Miranda Ribeiro, 1918 (Siluriformes: Loricariidae) from the upper rio Doce basin, Brazil, Neotropical Ichthyology, 5 (4), 2007, pp.443-448.
- E.S. Andrade, E.A. Andrade, V.O. Felizardo, D.A.J. Paula, G.C. Veras, and L.D.S. Murgas, Biologia reprodutiva de peixes de água doce. Revista Brasileira de Reprodução Animal, 39 (1), 2015, pp.195-201.
- G. Barbieri, and J.R. Verani, O fator de condição como indicador do período de desova de *Hypostomus* aff. *Plecostomus* (Linnaeus, 1758) (Osteichthyies, Loricariidae) na represa de Monjolinho, Ciência e Cultura, 39(7), 1987, pp.655-58.
- G. Haglund, Feature: L-number dazed. Aquarium World Magazine, 60 (3), 2014, pp. 6-13.



- G. Prang, An industry analysis of the freshwater ornamental fishery with particular reference to the supply of Brazilian freshwater ornamentals to the market, *Uakari*, 3 (1), 2007, pp.7-51.
- G.A. Ballen, and R.P. Vari, Review of Andean armored catfishes of the genus *Dolichancistrus* (Siluriformes: Loricariidae), *Neotropical Ichthyology*, 10 (3), 2012, pp.499-518.
- H. Anatole, J. Bessa, and L. Py-Daniel, Expedição para a identificação e avaliação de espécies não descritas de Loricarídeos explorados com finalidade ornamental no rio Xingu. 2008 COOPE. Retrieved from <http://www.ibama.gov.br/phocadownload/peixesornamentais/2008/2008>
- H.D.B. Anjos, and C.R. Anjos, Biologia reprodutiva e desenvolvimento embrionário e larval do cardinal tetra, *Paracheirodon axelrodi* Schultz, 1956 (Characiformes: Characidae), em laboratório. *Boletim do Instituto de Pesca*, 32(2), 2006, pp.151-160.
- H.D.B. Anjos, R.M.S. Amorim, J.A. Siqueira, and C.R. Anjos, Exportação de peixes ornamentais do estado do Amazonas, Bacia Amazônica, Brasil. *Boletim do Instituto de Pesca*, 35 (2), 2009, pp.259-274.
- H.I. Suzuki, A.A. Agostinho, and K.O. Winemiller, Relationship between oocyte morphology and reproductive strategy in Loricariid catfishes of the Paraná River, Brazil, *Journal of Fish Biology*, 57, 2000, pp.791-807.
- H.L.M. Moreira, L. Vargas, R.P. Ribeiro, and S. Zimmermann, Fundamentos da moderna aquicultura, Canos: Editora Ulbra 2001.
- H.P. Godinho, Estratégias reprodutivas de peixes aplicadas à aquicultura: bases para o desenvolvimento de tecnologias de produção. *Revista Brasileira de Reprodução Animal*, 31 (3), 2007, pp.351-360.
- I. Fichberg, and C.C. Chamon, *Rineloricaria osvaldoi* (Siluriformes: Loricariidae): a new species of armored catfish from rio Vermelho, Araguaia basin, Brazil, *Neotropical Ichthyology*, 6, 2008, pp.347-354.
- I. Seidel, Besonderes von der gattung *Hypancistrus*, Amazonas Sübwasser Aquaristik-Fachmagazin, 1 (2), 2005, pp.16-38.
- I. Seidel, New information on the Zebra Pleco, *Hypancistrus zebra*, *Tropical Fish Hobbyist*, 44 (5), 1996, pp.1-5.
- I.J.H. Isbrücker, and H. Nijssen, *Hypancistrus zebra*, a new genus and species of uniquely pigmented Ancistrine Loricariidae fish from the Rio Xingu, Brazil, *Ichthyological Exploration of Freshwaters*, 1 (4), 1991, pp.345-350.
- ICMBio. Livro Vermelho da Fauna Brasileira Ameaçada de Extinção – Instituto Chico Mendes de Conservação da Biodiversidade, ICMBio, 2016.
- J.W. Armbruster, *Hypancistrus inspector*: A new species of suckermouth armored catfish (Loricariidae: Ancistrinae), *Copeia*, 1, 2002, pp. 86-92.
- J.W. Armbruster, N.K. Lujan, and D.C. Taphorn, Four new *Hypancistrus* (Siluriformes: Loricariidae) from Amazonas, Venezuela, *Copeia*, 1, 2007, pp.62-79.
- J.W. Armbruster, Phylogenetic relationships of the suckermouth armored catfishes (Loricariidae) with emphasis on the Hypostominae and the Ancistrinae, *Zoological Journal of the Linnean Society*, 141, 2004, pp.1-80.
- L.D. Solis-Murgas, V.O. Felizardo, M.R. Ferreira, E.S. Andrade, and G.C. Veras, Importância da avaliação dos parâmetros reprodutivos em peixes nativos. *Revista Brasileira de Reprodução Animal*, 35, 2011, pp.186-191.

- L.H.R. Py-Daniel, and C. Cox-Fernandes, Dimorfismo sexual em Siluriformes e Gymnotiformes (Ostariophysi) da Amazônia, *Acta Amazonica*, 35 (1), 2005, pp.97-110.
- L.H.R. Py-Daniel, J. Zuanon, and R.R.D. Oliveira, Two new ornamental loricariid catfishes of Baryancistrus from rio Xingu drainage (Siluriformes: Hypostominae), *Neotropical Ichthyology*, 9 (2), 2011, pp.241-252.
- M. Camargo, T. Giarrizzo, and V. Isaac, Review of the geographic distribution of fish fauna of the Xingu river basin, Brazil, *Ecotropica*, 10, 2004, pp.123-147.
- M. Tan, and J.W. Armbruster, Two new species of spotted Hypancistrus from the Rio Negro drainage (Loricariidae, Hypostominae). *Zookeys*, 552, 2016, pp.123-135.
- M.A. Pedersen, Smuggler's Favorite, the Zebra Pleco "L46" Receives CITES Listing. *Amazonas Magazine*, 2016. Retrieved from <http://myemail.constantcontact.com/Zebra-Plecos-get-CITES-Protection-and-Into-the-Headwaters-of-the-Amazon>
- M.A. Rotta, Aspectos biológicos e reprodutivos para a criação da tucuna (*Gymnotus* sp.) em cativeiro. Embrapa, 2004.
- M.P.A. and M.M.A. Instrução normativa interministerial do Ministério da Pesca e Aquicultura e Ministério do Meio Ambiente; nº 1, de 3 de janeiro de 2012. Brasília, 2012.
- M.P.A. Instrução normativa do Ministério da Pesca e Aquicultura; nº 21 de 11 de setembro de 2014. Brasília, 2014.
- M.S. Rodríguez, and A.M. Miquelarena, A new species of Rineloricaria (Siluriformes: Loricariidae) from the Paraná and Uruguay River basins, Misiones, Argentina. *Zootaxa*, 945, 2005, pp.1-15.
- N.K. Lujan, M. Hidalgo, and D.J. Stewart, Revision of Panaque (Panaque), with descriptions of three new species from the Amazon basin (Siluriformes, Loricariidae), *Copeia*, 4, 2010, pp.676-704.
- P. Martínez, A.M. Viña, L. Sánchez, N. Díaz, L. Ribas, and F. Piferrer, Genetic architecture of sex determination in fish: applications to sex ratio control in aquaculture, *Frontiers in Genetics – Livestock Genomics*, 5 (340), 2014, pp.1-13.
- P.A. Buckup, and G.M. Santos, Ictiofauna da Ecorregião Xingu: fatos e perspectivas, *Boletim da Sociedade Brasileira de Ictiologia*, 98, 2010, pp.3-9.
- R Core Team. *R: a language and environment for statistical computing*, 2020. Retrieved from <https://www.R-project.org/>
- R. Covain, and S. Fisch-Muller, The genera of the Neotropical armored catfish subfamily Loricariinae (Siluriformes: Loricariidae): a practical key and synopsis. *Zootaxa*, 1462, 2007, pp.1-40.
- R. Froese, Cube law, condition factor and weight-length relationships: history, meta-analysis and recommendations, *Journal of Applied Ichthyology*, 22 (4), 2006, pp.241–253. doi:10.1111/j.1439-0426.2006.00805.x
- R.R. Oliveira,; L.H.R. Py-Daniel, J. Zuanon, and M.S.A. Rocha, New species of the ornamental catfish genus Peckoltia (Siluriformes: Loricariidae) from rio Xingu Basin, Brazilian Amazon, *Copeia*, 3, 2012, pp.547–553.
- S. Chellappa, A. Huntingford, R.H.C. Strangs, and R.Y. Thomson, Condition factor and hepatosomatic index as estimates of energy status in male three-spined stickleback, *Journal of Fish Biology*, 47, 1995, pp.775-787.

S. Saurabah, N. Sridhar, G. Barlya, A. Hemaprasanth, C.H. RaghaVendra, M.R. Ragunath, and P. Jayasankar, Sexual dimorphism in fish, *Aqua International*, 1, 2013, pp.30-32.

U. Khatri, Indigenous peoples' right to free, prior, and informed consent in the context of state-sponsored development: The new standard set by Sarayaku V, Ecuador and its potential to delegitimize the Belo Monte Dam, *American University International Law Review*, 29 (1), 2013, pp.164-207.

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

## **Operational Sustainability of the Firm The operational performance versus financial solvency binomial - OPFS**

**Doctor Jos Antonio DE FRAN A.** Accountant and Economist, Professor of the Department of Accounting and Actuarial Sciences at the University of Brasilia, Brazil.

Email: [franca@itecon.com.br](mailto:franca@itecon.com.br) and [franca@unb.br](mailto:franca@unb.br).

ORCID: <https://orcid.org/0000-0002-8233-3620>

**Nathália Alves de CARVALHO.** Holds a Bachelor Degree in Accounting  
University of Brasília (UnB).

Email: [nathaliaalveescarvalho@gmail.com](mailto:nathaliaalveescarvalho@gmail.com)

**Doctor Clésia Camilo Pereira.** Accountant, Professor of the Department of Accounting and Actuarial Sciences at the University of Brasília, Brazil. Email: [clesia@unb.br](mailto:clesia@unb.br).

**Doctor Eduardo Tadeu VIEIRA.** Accountant, Director of the Faculty of Economics, Administration, Accounting and Public Management at University of Brasilia, Professor of the Department of Accounting and Actuarial Sciences at the University of Brasilia, Brazil. Email: [eduardot61@hotmail.com](mailto:eduardot61@hotmail.com) and [eduardot@unb.br](mailto:eduardot@unb.br).

### **ABSTRACT**

*This article presents the research results that assess a firm's operational sustainability by combining the Degree of Operating Leverage (DOL) with the Current Liquidity Ratio (CLR) to present the Operational Performance versus Financial Solvency (OPFS) binomial, using a non-parametric model. The combination of the DOL with the CLR identifies metrics that indicate that a firm operates at full installed capacity and injects synergy at the generation of financial assets. The model was tested with data from standardized financial statements from 48 firms distributed among 6 sectors of the Brazilian economy, from 2007 to 2017. The results obtained suggest that, when a firm operates at full installed capacity, the DOL varies between 1 and 2, and the CLR is higher than the DOL. From the 6 sectors contemplated by the sample, 4 stand out by operating at full installed capacity with the CLR higher than the DOL, and 2 sectors signal some idleness with the DOL above 2 and the CLR lower than the DOL, such as the Public Utilities Sector (PU) indicating the highest efficiency among all. These results are relevant to illustrate that the combination of the DOL with the CLR is robust enough to evaluate a firm's operational sustainability.*

**Key-words:** Operational Performance versus Financial Solvency, nominal payment capacity, degree of operating leverage (DOL), firm's operational sustainability.

## 1 INTRODUCTION

This article presents the *Operational Performance versus Financial Solvency* (OPFS) binomial as a reference indicator to signal a firm's operational sustainability, resulting from the combination of the Degree of Operating Leverage (DOL), which measures the level of applicability of the installed capacity, with the Current Liquidity Ratio (CLR), which represents the nominal payment capacity in the short term.

The **DOL**, as approached in the literature, refers to a measure of profit sensitivity in relation to the variation of the sales' net operating income, as in Garrison, Noreen & Brewer (2013), or to the potential use of fixed costs to increase the effects of changes on sales in relation to profit, as addressed by Gitman (2002). The **CLR**, in turn, is the indicator that shows the sufficiency of the net working capital in the solvency of a firm's obligations, as widely addressed in the literature.

In a study that assesses the optimal level of **DOL**, controlled by the sales' net income, De França and Lustosa (2011) and De França (2012) introduce robust evidences that a firm is economically efficient if it presents a **DOL** around 2. Said study takes into consideration that the firm uses constant installed capacity, in terms of plant, to a certain production volume, in an estimated time period, because it implies the maintenance and linearity of fixed costs (**FC**), as discussed by Van Horne and Wachowich (1975). By using the DOL as a starting point, and linearly combining it with the CLR, the present article aims at proposing a model of operational sustainability of a firm.

Traditionally, liquidity is evaluated with **CLR**-focused financial indicators, with an expected score at least equal to 1. Despite the **CLR** being widely used as the ratio for the relation between a firm's current asset (CA) and current liability (CL), it does not reveal the effective payment capacity since it does not incorporate time estimators, as argued by Richards and Laughlin (1980), and Assaf Neto (2014). This CLR limitation was studied by De França and Sandoval (2019), who incorporated into it the effects of the operating cycle and the financial cycle, which resulted in the proposition of the Liquidity Sustainability Ratio (LSR).

But, even if the CLR incorporates time estimators, like the operating cycle and the financial cycle, it is not able to guarantee effective liquidity, because market events called *immediacy*, as discussed by Grossman and Miller (1988), cannot be captured since they read past transactions, in a given period in time. In addition to this observation, Diamond and Rajan (1999) also add capital structure fragility that allows the relationship lender to take loans against the full value of granted illiquid loans, making financial fragility create liquidity.

In the short term, the **DOL**, as an operational performance indicator, signals the efficiency level in the allocation and use of **FC**, whereas the **CLR** only indicates the nominal capacity of the financial and non-financial assets to liquidate the obligations, even if this signal depends on the timeliness of asset liquidation.

A firm's operational dynamics promotes constant modifications on the assets that compose the means of payment of obligations and on the assets destined to production. The combination of these modifications, which are reflected on the relationship between the **DOL** and the **CLR**, constitutes the main motivation of this research. The assets that compose the means of payment and those destined to production are the ones declared, respectively, in the current asset and in the fixed asset of a firm's financial statement.

Because of the importance of this theme for the literature and for the market, by using data from standardized financial statements from a sample of 48 firms listed on B3 (*Brasil, Bolsa, Balcão*), distributed in six sectors of the Brazilian economy from 2007 to 2017, this research investigates a firm's sustainability through the combination of the DOL with the CLR, supported by the OPFS binomial metrics, within the liquidity context. To conduct this investigation, the established goals are (a) to calculate the DOL and its relationship with FC, EBIT (Earnings Before Interest Tax), and CLR; (b) to test the differences between the means and analyze the descriptive statistics from the six sectors of the economy contemplated in the sample; and (c) to test the behavior of the CLR level in relation to the DOL level to evaluate the firm's operational sustainability signaled by the OPFS.

Within this context, the research presents the OPFS as a linear combination of the **DOL** with the **CLR** to measure a firm's sustainability in the generation of financial assets, indicated by the nominal payment capacity measured by the CLR.

The expected results are relevant for the literature as they signal that a firm operating with optimal use of its installed capacity generates financial assets that inject synergy into the nominal payment capacity measured by the CLR. The results also differ from those from previous studies because they identify the sectors of the economy that best combine the DOL with the CLR to indicate a firm's operational sustainability.

In addition to this introductory section, the article is structured as follows: section **2, Operating Leverage**, discusses the concepts and contributions of the DOL as an indicator of a firm's operational performance. Section **3, Liquidity as nominal payment capacity**, discusses significant contributions of the literature about the limitation of the liquidity index as nominal payment capacity. Section **4, Firms by sectors of the economy and variables of interest**, identifies the firms of the sample, the sectors of the economy in which the firms operate, and describes the variables of interest. Section **5, Methodology**, specifies and describes the equations that compose the research model. Section **6, Result Analysis**, analyzes the responses of the sample data produced by the application of the research model. Section **7, Conclusions**, summarizes the main research findings; and, lastly, **References**, and the **Appendix**.

## 2 OPERATING LEVERAGE

Operating Leverage, as addressed by Gitman (2002), is understood as the potential use of fixed costs, of an operational nature, to increase the effect on profit as a consequence of the changes in the sales revenue.

Equivalently, operating leverage is also identified as an indicator of economic efficiency, in the use of the installed capacity, which shows that a firm still has a margin to absorb fixed costs with an increase in production, or that it already operates at an optimal level of efficiency. This context is explored by Garrison, Noreen, and Brewer (2013) to indicate the DOL as a measure of profit sensitivity in relation to the variation of the sales net income, acting as a multiplier. This declaration is at first supported by Van Horne and Wachowich (1975), who link operating leverage to the installed capacity that produces fixed costs, maximizes production, and eliminates idleness.



De França and Lustosa (2011) and De França (2012) studied the relations of the DOL with a firm's profit and cost structure. This study reveals that the lower the DOL, the higher the profit, establishing an inverse relation between the two, and, consequently, the firm's operational performance is more robust. On the other hand, the higher the DOL, the higher the unused fixed cost, revealing idleness of the installed capacity. The study also shows that, for a firm with optimal operational performance, the DOL must be around 2. These results are aligned with the findings of Stowe and Ingene (1984) and Gahlon (1981), who reveal that the DOL's elasticity is inverse to that of the operational profit as well as to the sales elasticity.

Within the context of marginal productivity, Mankiw (2009) states that a firm reaches an optimal DOL, as an operational efficiency concept, when the marginal revenue equals the marginal cost, showing that, at full employment, the installed capacity would be used at its full potential, without idleness.

### **3. LIQUIDITY AS NOMINAL PAYMENT CAPACITY**

Liquidity is composed of a set of indicators that measure specific stages of a firm's financial capacity. In the literature, in general, these indicators measure a nominal liquidity because they only prioritize the relation between the values, this also being the context of the present study when it comes to the choice of the current liquidity ratio (CLR).

The CLR, as an indicator of nominal payment capacity, reveals the relation between the positive part and the negative part of a firm's working capital, in terms of quotient. As addressed by Assaf Neto (2014), the CLR has the objective of measuring a firm's payment capacity or its ability to fulfill its obligations. With this approach, it is expected that the CLR, resulting from the relation between the current asset (CA) and the current liability (CL), be a ratio at least equal to 1. However, this CLR quantum does not take into consideration the requirements of activity indicators, and mainly, the closure of the financial cycle; that is why it can only be accepted within the context of nominal payment capacity.

Contradicting the traditional concepts of nominal liquidity measured by the CLR, Richards and Laughlin (1980) analyzed the literature's contributions to working capital management and observed that it receives less attention than the others. Their contributions alert that such inattention may result in inefficiency due to short-term adverse events, and signal that a sole test of the conventional liquidity relations and the statistics of financial statements may generate bias on a firm's nominal liquidity positions, since they do not incorporate time estimators. According to this statement, the CLR requires a combination with activity indicators in order to be effective.

But nominal liquidity can be implicated by a manipulation bias, as indicated by Gill and Mathur (2011). The authors state that they investigated factors that influence liquidity management in firms in Canada, based on a sample of 164 firms listed on the Toronto Stock Exchange, from 2008 to 2010. They argue that managers have the power to transform assets in their benefit because they have implicit rights over the assets' liquidity, and that an alteration on this liquidity would affect such rights. Lastly, they conclude that liquidity retention is also influenced by the firm's size, by the net working capital, the almost liquidity, short-term debt, investments, and by internationalization and business segment.

Lancaster, Stevens and Jennings (1998) also analyzed the relations between liquidity and competence-driven acknowledgement versus cashflow in static and dynamic aspects. They declare to "have found

evidence that the operations' cashflow is significantly related to the liquidity ratios and with the financial cycle, and that this relation has incremental and significant explanation for the revenue of each period".

Grossman and Miller (1998) analyzed liquidity in light of the stock market crisis of 1987, through the price perspective. They present models that show the limitations of traditional liquidity but that are not the solution for preventing future stock market crashes. Even though the liquidity discussed by the authors is aimed at the financial market, the context is applicable to this study because the CLR also measures nominal solvency in a given period, and, due to market adversities, it does not guarantee the condition for future payment because of the change in consumers' purchasing power and in macroeconomic conditions.

The liquidity fragility in the banking sector was analyzed by Diamond and Rajan (1999), who discuss that fragility of the capital structure enables the relationship lender to take loans against the full value of the illiquid loan they hold, and that, due to a liquidity shock, financial fragility enables the creation of liquidity. This context is pertinent to the theme of the present article because, when a non-financial firm offers its clients credit, in order to obtain solvency, it negotiates these credits at a necessary amount to get flow while liquidity with the clients does not occur.

Studying the CLR limitations, De França and Sandoval (2019) incorporate into this indicator the effects of the operating cycle and the financial cycle to adjust the nominal payment capacity to the effective capacity and, with that, they present the Liquidity Sustainability Ratio (LSR) that approximates the CLR to a financial solvency indicator.

The revision and discussion explored in this section does not claim to have exhausted the literature's contributions, but rather to have recovered those that are most identified with and most contribute to the conducted research. As surmised by the analysis of the contributions, liquidity can be influenced by several factors apart from the DOL's performance, yet the research focus is limited to the DOL versus LCR binomial and, complementarily, DOL with FC and EBIT.

#### **4 FIRMS BY ECONOMY SECTORS AND VARIABLES OF INTEREST**

To identify the firms that have publicly released their management data through standardized financial statements, the B3 (former BM&FBOVESPA) repository was consulted, within the reference period of the research. Once the firms were identified, the next step was to gather the data from the aforementioned standardized financial statement, recovering them from the consulting platform Economática's database, and to elect the firms that meet the research criteria. The research criteria are: completeness of the standardized financial statement, required by the accounting standard, and that the selected firms be distributed over six sectors of the economy (Table A2)

The variables of interest (Table 1), all quantitative, are associated to the specification of the model to promote the answers for the research inquiries.

Table 1: Variables of interest of the research that compose the analytical model equations.

Variable	Denomination	Description
<b>DOL</b>	Degree of Operating Leverage	It is a measure of operational risk, which assesses the sensitivity of profit in relation to the sales variation. It measures the level of a firm's installed capacity usage. The closer it gets to 2, the higher the firm's economic efficiency is.
<b>FC</b>	Fixed Cost	It is the dimensioned cost for the size of the plant. In unitary terms, it decreases. The closer the firm's production is to the full employment of the installed capacity, the lower the unitary value of the fixed cost is.
<b>EBIT</b>	Earnings before interest and taxes	It is the profit seen as a management measure. It does not include taxes nor direct taxes over profit. It must be positive ( $EBIT^+$ ).
<b>GP</b>	Gross Profit	It is the difference between net income and variable cost, and must be sufficient to recover remaining costs, taxes, and the shareholders' compensation. It is also called Contribution Margin (CM).
<b>PTIB</b>	Profit before income taxes	It is the profit of the firm before direct tax over profit (DT).
<b>DT</b>	Direct tax over profit	Corporate Income Tax (IRPJ in portuguese) and social contribution on net profit (CSLL in portuguese).
<b>SE</b>	Sales Expenses	They are the variable expenses related to sales operations.
<b>FR</b>	Financial Result	It is the difference between earnings with the application of financial assets and the expenses in the employment of a firm's financial obligations.
<b>PE</b>	Patrimonial Equivalence	It is the difference between the profits and the losses obtained by a firm with related-party investments.
<b>CLR</b>	Current Liquidity Ratio	It is the quotient between the current asset (CA) and the current liability (CL) of the Financial Statement and measures the firm's nominal payment capacity at a point in time, in the short term.
<b>CA</b>	Current Asset	Account group that accumulates cashflow and cashflow equivalent, receivable and stock inventories with expected realization in the short term (12 months).
<b>CL</b>	Current Liability	Account group that accumulates demandable obligations in the short term (12 months).

Variable	Denomination	Description
<b>OPFS</b>	<i>Operational Performance and Financial Solvency</i>	Reference indicator of a firm's sustainability, resulting from the combination of the Degree of Operating Leverage (DOL) and the Current Liquidity Ratio (CLR).
<b>NCC</b>	Net Current Capital	Difference between the CA and the CL. Is expected to be positive or negative ( $NCC^{\pm}$ ). It is also called net working capital (NWC).

Source: Authors

## 5 METHODOLOGY

The methodology is analytical, supported by a non-parametric model. The model is composed of functional equations that measure the DOL (equation 1), the FC (equation 2), the CLR (equation 3), the EBIT (equation 4), means and differences between means (equations 5 and 6), the OPFS (equation 7). For every equation,  $j$  is the firm and varies from 1 to 48,  $k$  is the sector of the economy and varies from 1 to 6, and  $t$  is the quarter, in each year, and varies from 1 to 4.

### a) DOL

As an operational risk measure, the DOL is not directly observed on standardized financial statements. The DOL reveals the level of usage of a firm's installed capacity. It indicates that the firm tends to optimal production if the DOL quantum varies between 1 and 2. But, for a DOL equal to 1, this would imply fixed cost equal to zero, or a profit tending to infinity, which are not feasible hypotheses in the business world. For a DOL equal to 2, it implies the fixed cost to be equal to the profit, as equation (1) shows.

$$DOL_{jkt} = 1 + \frac{FC_{jkt}}{EBIT_{jkt}} \geq 1, \quad \forall EBIT_{jkt} > 0 \quad (1)$$

Given that, at the installed capacity level, the FC is constant, the DOL is inverse to the EBIT. Hence, when the EBIT decreases/increases, the DOL increases/decreases.

**Theorem 1:** The necessary condition for the DOL to be 1 is:

If the FC tends to zero and the  $EBIT^+$  is much higher than the FC, this implies that the second term, to the right, of Equation (1) equals zero.

**Proof 1:**

$$\frac{FC_{jkt}}{EBIT_{jkt}} \rightarrow 0. \quad FC \rightarrow 0, \quad EBIT \rightarrow +\infty, \text{ therefore, } \frac{0}{\infty} \equiv 0.$$

**Theorem 2:** The necessary condition for the DOL to be 2 is:

If the FC and the  $EBIT^+$  have equal value, this implies that the second term, to the right, of Equation (1) is equal to 1.

**Proof 2:**

$$\forall FC, EBIT > 0, FC = EBIT, \frac{FC_{jkt}}{EBIT_{jkt}} = 1.$$

### b) FC

The **FC** is distributed over a firm's production cost and general expenses. That is why it is not directly observed on standardized financial statements. Thus, a reasonable way to obtain it is through proxy. The FC volume is related to the firm's plant size.

$$FC_{jkt} = GP_{jkt} - PTIB_{jkt} - SE_{jkt} + FR_{jkt} + PE_{jkt} > 0 \quad (2)$$

Given the firm's installed capacity (plant), theoretically, the FC is constant in volume.

#### c) CLR

As a nominal payment capacity, the CLR is the commonly used indicator to measure a firm's liquidity in the short term. The quantum expectation is for it to be at least equal to 1. However, its variation scale depends on the magnitude of the net current capital's value and signal ( $NCC^{\pm} = CA - CL$ ).

$$CLR_{jkt} = \frac{CA_{jkt}}{CL_{jkt}} > 0 \quad (3)$$

For the specification of the model to any  $NCC \geq 0$ , the answer is  $CLR \geq 1$ . Otherwise,  $CLR < 1$ .

#### d) EBIT

As a measure of adjusted profit, it is not directly observed on standardized financial statements. As a management performance indicator, it excludes from managers' evaluations the variables that they do not control.

$$EBIT_{jkt} = PTIB_{jkt} + FR_{jkt} + DT_{jkt} > 0 \quad (4)$$

#### e) Mean ( $\bar{X}$ )

The result obtained is a parametric indicator of all variables of interest (VI) in the central position.

$$\bar{X}_{jkt} = \frac{VI_{jkt}}{n} > 0 \quad (5)$$

In which VI is the variable of interest (DOL, EBIT, CLR, FC).

#### f) Test of difference between means ( $t_{test}$ )

The metric of this test is the distribution  $t$  (Student), as in Spiegel (1993, p. 286), used to differentiate a segment from another or a firm from another. The comparison is made with the critical statistical parameter ( $t_{critical}$ ). If  $t_{test} > t_{critical}$ , this implies that the means are not equal. Otherwise, the hypothesis that the means are not different is not rejected.

$$t_{test_{jkt}} = \frac{\bar{X}_{jkt} - \bar{Y}_{jkt}}{\sqrt{\frac{X_{x_{jkt}}^2}{n_{jkt}} + \frac{Y_{y_{jkt}}^2}{n_{jkt}}}} \quad (6)$$

In which  $\bar{X}_{jkt}$  is the mean of the reference sector;  $\bar{Y}_{jkt}$  is the mean of the compared sector;  $\frac{X_{x_{jkt}}^2}{n_{jkt}}$  is the reference variance;  $\frac{Y_{y_{jkt}}^2}{n_{jkt}}$  is the variance of the compared sector.

The test results are expected to be symmetrical with any level of statistical significance.

#### g) OPFS

As a reference indicator of a firm's *Operational Performance versus Financial Solvency* binomial, the OPFS shows a combination of the level of employment of the installed capacity with the nominal liquidity.

$$OPFS_{jkt} = DOL_{jkt} * CLR_{jkt}^{-1}, \quad (7)$$

$$OPFS_{jkt} = \begin{cases} 1 & \text{if } DOL = CLR \\ > 1 & \text{if } DOL > CLR \\ < 1 & \text{if } DOL < CLR \end{cases}$$

**Statement 1:  $DOL = CLR$**

At an optimal level of usage of a firm's installed capacity ( $1 < DOL \leq 2$ ), an OPFS equal to 1 implies that the DOL and the CLR are equal. As the CLR is a nominal payment capacity indicator, this quantum meets the firm's liquidity demand. However, this identity can occur in other intervals, but without the full use of the installed capacity.

**Statement 2:  $DOL > CLR$**

For OPFS higher than 1 and ( $1 < DOL \leq 2$ ), the signal is that the CLR quantum varies within the interval of 1 and 2, but is lower than the DOL quantum. If the CLR quantum is lower than 1, this jeopardizes the firm's nominal payment capacity. However, if the firm is not operating at an optimal usage level of the installed capacity, the DOL quantum is expected to be higher than the CLR quantum. In this case, the nominal payment capacity will only be jeopardized if  $NCC \leq 0$ .

**Statement 3:  $DOL < CLR$**

If the OPFS is lower than 1, necessarily  $\frac{FC_{jkt}}{EBIT_{jkt}} < 0$ . This situation implies that the firm needs other sources to generate financial assets to honor the short-term commitments.

## 6 RESULTS ANALYSIS

The results are presented in a comparative, intra-sectoral and intersectoral manner, for every model variable, obtained through the specified equations of the previous section, by using the free domain statistical packet *gretl*. As already indicated, the sample is composed of data from standardized financial statements from 48 firms (Table A1), distributed over 6 sectors of the economy (Table A2), totalizing 2,112 quarterly observations, from 2007 to 2017. The test results are exhibited in Tables 2, 3, 4, and 5, respectively, the differences between the means, correlation matrix coefficients, descriptive statistical estimators, and OPFS binomial.

### 6.1 Analysis of the test on the difference between means

The coefficients of the differences between the means are exhibited in Table 2 and were obtained according to the model defined by Equations (e) and (f) of section 5. The tested variables are FC, EBIT, DOL and CLR, as defined in Table 1. The test results are symmetrical and signal that the hypothesis that the means are not different cannot be rejected, considering that the observed differences are lower than the standardized parameters of statistics  $t$  ( $t_{test} < t_{critical}$ ) for trust levels of 90%, 95% and 99% (1.43; 1.94



e 2.44). However, regarding the DOL variable, in the HC vs PU combination, the hypothesis that the means are not different is successful at 99% of trust; in the HC vs NCS, HC vs IG, and HC vs FN, the hypothesis of no difference between the means is observed at 95% and 99% of trust. These results are relevant to indicate that the intra-sectoral and intersectoral Brazilian economy is competitive.

It is relevant still to observe that the differences between means are centered at less than one standard deviation, except in DOL test (c), in the combinations HC vs IG; HC vs NCS; HC vs FN; and HC vs PU, which present scores between 1.40 and 2.24.

Table 2: Difference between variables of interest's two-tailed means by sector of the Brazilian economy: 2007:1 to 2017.

Sectors	IG	CS	NCS	FN	HC	PU
<b>a) FC Means Test</b>						
		-	-		-	-
IG	0	0.4240	0.6618	0.3050	0.4240	0.5655
			-			-
CS	0.4240	0	0.5141	0.6992	0.0931	0.1563
NCS	0.6618	0.5141	0	0.7324	0.5546	0.4468
	-	-	-		-	-
FN	0.3050	0.6992	0.7324	0	0.8435	0.8204
		-	-			-
HC	0.4240	0.0931	0.5546	0.8435	0	0.2647
			-			
PU	0.5655	0.1563	0.4468	0.8204	0.2647	0
<b>b) EBIT Means Test</b>						
		-	-			-
IG	0	0.5862	0.7071	0.0086	0.1291	0.6999
			-			-
CS	0.5862	0	0.5068	0.6757	0.8131	0.3480
NCS	0.7071	0.5068	0	0.7182	0.7484	0.2745
	-	-	-			-
FN	0.0086	0.6757	0.7182	0	0.1739	0.7323
	-	-	-	-		-
HC	0.1291	0.8131	0.7484	0.1739	0	0.7923
			-			
PU	0.6999	0.3480	0.2745	0.7323	0.7923	0
<b>c) DOL Means Test</b>						
		-			-	
IG	0	0.2905	0.0572	0.2704	1.4044	0.7645

Sectors	IG	CS	NCS	FN	HC	PU
CS	0.2905	0	0.3070	0.3676	0.1711	0.4770
NCS	0.0572	0.3070	0	0.2189	1.4768	0.7195
FN	0.2704	0.3676	0.2189	0	1.6461	0.4427
HC	1.4044	0.1711	1.4768	1.6461	0	2.2420
PU	0.7645	0.4770	0.7195	0.4427	2.2420	0

**d) CL Means Test**

IG	0	0.2336	0.4741	0.2753	0.0996	0.0631
CS	0.2336	0	0.4497	0.3711	0.2064	0.1522
NCS	0.4741	0.4497	0	0.1190	0.7872	0.0246
FN	0.2753	0.3711	0.1190	0	0.4198	0.0005
HC	0.0996	0.2064	0.7872	0.4198	0	0.0796
PU	0.0631	0.1522	0.0246	0.0005	0.0796	0

The meaning of the acronyms is described in Tables 1 and A2.

**6.2 Analysis of the coefficients of the correlation matrix**

The coefficients of the correlation matrix are shown in Table 3, in the set of firms, by variable, segregated by sector of the economy.

The answer to the DOL versus EBIT association shows an inverse relation in the six sectors of the economy. This inverse relation confirms the theory by showing that, when the EBIT increases/decreases, the DOL decreases/increases, as discussed by Stowe and Ingene (1984) and Gahlon (1981). The DOL versus FC association, in sectors IG, FN, and PU, shows a direct relation, confirming that the increase in FC implies an increase in DOL, but in sectors CS, NCS, and HC, the relation is inverse, contradicting the theoretical premise. The research did not investigate the reason for this violation of the premise.

The DOL versus CLR association shows a direct relation in sectors IG, FN, and HC, but, in sectors CS, NCS, and PU, the relation is inverse. The direct relation cannot be explained by the model because the DOL's quantum growth would imply a quantum reduction of the CLR, because it signals that there would be idle fixed cost, and, consequently, a lower generation of financial assets. But the inverse relation

is in accordance with the theoretical premise because the quantum reduction of the DOL implies an absorption of fixed cost by the sales income with a consequent increase in financial assets.

Table 3: Coefficients of the correlation matrix of the DOL association with the sectoral variables of the Brazilian economy: 2007:1 to 2017:4

	<i>FC</i>	<i>EBIT</i>	<i>DOL</i>	<i>CLR</i>	<i>FC</i>	<i>EBIT</i>	<i>DOL</i>	<i>CLR</i>
<b>a) IG</b>					<b>b) CS</b>			
FC	1				1			
EBIT	0.9387	1			0.6573	1		
DOL	0.0952	-0.1251	1		-0.0135	-0.0590	1	
CLR	0.1936	0.1659	0.1293	1	-0.2458	-0.2787	-0.0147	1
<b>c) NCS</b>					<b>d) FN</b>			
FC	1				1			
EBIT	0.8901	1			0.6892	1		
DOL	-0.0146	-0.1187	1		0.3156	-0.2834	1	
CLR	-0.2707	-0.2269	-0.1285	1	0.0911	0.1427	0.0040	1
<b>e) HC</b>					<b>f) PU</b>			
FC	1				1			
EBIT	0.7921	1			0.8180	1		
DOL	-0.0013	-0.2812	1		0.2274	-0.1059	1	
CLR	-0.3761	-0.3986	0.0330	1	-0.0719	-0.0688	-0.1072	1

The meanings of the acronyms are listed in Tables 1 and A2.

### 6.3 Descriptive Statistics

The estimators of the descriptive statistics of the observations of the distribution are presented in Table 4, by research variable and sector of the economy, in the set of the time horizon. It is immediately observable that, in all six productive sectors of the economy and in all variables, the mean is located in the upper part of the median. This reveals that more than half of the observations of the distribution, in the sample's time horizon, are below the mean.

In the FC and EBIT economic variables, the distance between the mean and median estimators is significantly large, but this distance can be explained by the size of the firm. Regarding the DOL and CLR variables, as they are not influenced by the size of the firm, the distance can be explained by operational performance.

In the productive sectors IG, FN, NCS, and PU, the average DOL is within the range from 1 to 2, which suggests that the firm operates at the optimal level of installed capacity, even if it presents an

excessively large coefficient in the higher part of the limit. In sectors CS and HC, the average DOL is located in a scale between 2 and 3, slightly above the interval that identifies the optimal use of the firm's plant. But this scale between 2 and 3 can also suggest an efficient production frontier, not necessarily meaning that firms with a DOL within this interval are not in full use of their installed capacity, even if they may have a fixed cost gap to be filled by the sales revenue. These results confirm the findings of De França and Lustosa (2011), who identified a DOL within these two intervals as a response of a firm's optimal production.

In relation to liquidity, the mean estimator reveals that sectors FN, NCS, and PU show a CLR quantum within the interval between 1.80 and 1.91; in sectors IG, CS, and HC, the estimator settles on a scale between 2 and 3. For all sectors, the CLR quanta satisfy the nominal payment capacity.

Thus, comparatively, the DOL mean estimators larger than 2 are in sectors CS and HC, and sectors IG, FN, NCS, and PU are within the interval larger than 1 and smaller than 2, indicating an optimal use of the installed capacity. Changing focus to the CLR average estimators, those larger than 2 are in sectors IG, CS, and HC, and sectors FN, NCS, and PU are in the interval larger than 1 and smaller than 2. This correspondence of magnitude between the DOL and CLR quanta is in line with the inverse behavior between these two indicators shown by the coefficients of the correlation matrix.

The intersectoral dispersion of the distribution of the CLR is lower than the standard deviation of the mean in sectors IG, FN, CS, HC, and NCS, and larger than 4 in the PU sector. In relation to the DOL, dispersion is only not lower than 1 standard deviation of the mean in sector CS, which corresponds to 5.49. In the other variables and sectors, dispersion is higher than 1 and lower than 2 standard deviations of the mean. This reveals that most observations of the distribution of the 48 firms, in the set of the time horizon, are concentrated around the mean, reinforcing the argument that Brazil's economy works in a competitive market.

Table 4: Descriptive Statistics of performance and liquidity by sector – 2007:1 to 2017:4

Estimators	FC	EBIT	DOL	CLR	FC	EBIT	DOL	CLR
<b>a) IG</b>					<b>b) FN</b>			
Mean	84,489	138,116	1.83	2.09	50,538	136,503	1.68	1.91
Median	33,268	61,944	1.54	2.08	19,450	1,188	1.40	1.85
Coef. Var.	1.44	1.48	0.64	0.32	1.29	1.15	0.57	0.48
Minimum	2,823	1,089	1.09	0.55	890	2,398	1.05	0.50
Maximum	681,682	1,182,412	11.56	4.16	291,336	654,242	7.89	4.69
Count	308	308	308	308	132	132	132	132
<b>c) CS</b>					<b>d) HC</b>			

Estimators	FC	EBIT	DOL	CLR	FC	EBIT	DOL	CLR
Mean	160,137	289,377	2.39	2.38	143,587	116,046	2.72	2.14
Median	79,041	199,797	1.50	1.66	84,214	65,320	2.34	2.00
Coef. Var.	1.37	1.08	5.49	0.76	1.13	1.21	0.52	0.32
Minimum	3,104	142	1.10	0.49	2,438	974	1.43	1.06
Maximum	1,620,132	2,038,218	262.02	10.19	824,663	792,584	12.49	5.86
Count	396	396	396	396	176	176	176	176
<b>e) NCS</b>					<b>f) PU</b>			
Mean	448,530	690,631	1.80	1.84	195,298	451,281	1.48	1.91
Median	156,053	307,169	1.61	1.67	112,241	295,783	1.40	1.11
Coef. Var.	1.96	1.84	0.38	0.34	1.17	1.15	0.28	4.30
Minimum	8,483	2,005	1.25	0.91	56	-1,503	0.75	0.14
Maximum	8,181,784	9,179,297	7.26	4.43	1,385,566	3,334,224	5.73	163
Count	264	264	264	264	836	836	836	836

The meanings of the acronyms are listed in Tables 1 and A2.

## 6.4 Analysis of the OPFS

In this analysis, an investigation is conducted on how the CLR quantum behaves in relation to the DOL quantum. The model specified in Equation (1), in 5(a), suggests that, when the firm operates at an optimal installed capacity, the DOL variates within the interval between 1 and 2. The model specified in Equation (3) reveals that the CLR, to support the nominal payment capacity, must be at least equal to 1. Equation (7), specified in 5(g), shows that the DOL relates linearly with the CLR to produce the OPFS coefficient. Thus, all else being equal, financial solvency must be understood, in the specific context of the OPFS, as a semantic equivalent to the nominal payment capacity.

The responses in Table 5 show OPFS scores lower than 1 and at least equal to 1. A score lower than 1 is a signal that the DOL produces synergy in the CLR quantum. A score higher than 1 indicates that the production of synergy of the DOL in the CLR quantum is reduced. And, for a score equal to 1, the DOL's contribution is indifferent.

In this context, sectors IG, FN, NCS, and PU show that the optimal use of the installed capacity increases the generation of financial assets because the CLR quantum is higher than the DOL quantum,

and this strengthens the nominal payment capacity. In the HC sector, the generation of financial assets is less strengthened by the DOL, even if the CLR shows a comfortable nominal payment capacity in being higher than 2 but lower than the DOL. Sector CS is indifferent because the DOL and the CLR show equal quanta. The most operationally efficient sector is that of public utilities (PU), for having the lowest DOL in the scale between 1 and 2, while the least efficient is health (HC), with the highest DOL.

Table 5: Operational performance and financial solvency of the sectors of the Brazilian economy: 2007:1 to 2017:4

Sectors	DOL	CLR	OPFS
IG	1.83	2.09	0.88
FN	1.68	1.91	0.88
CS	2.39	2.38	1.00
HC	2.72	2.14	1.27
NCS	1.80	1.84	0.98
PU	1.48	1.91	0.77

The meanings of the acronyms are listed in Tables 1 and A2.

As shown by the results, the OPFS model is adequately specified for indicating a firm's operational sustainability and that the Brazilian economy, both intersectoral and intra-sectoral, in the period encompassed by the sample, as an average, operates at full employment of the installed capacity in the firms, and confirms the opposing trend between the DOL and CLR quanta.

## 6.5 Summary of the analyses

In summary, the results of the analyses are robust in indicating that a firm's operational sustainability is indicated by the *Operational Performance versus Financial Solvency* – OPFS binomial, with the DOL within the interval between 1 and 2, and, in this interval, it promotes synergy in the generation of financial assets, with a reduction of the DOL level and growth of the CLR level.

## 7 CONCLUSIONS

This article brought into discussion the research results on a firm's *Operational Performance versus Financial Solvency* (OPFS), as a reference indicator of the combination of the level of usage of the installed capacity, measured by the Degree of Operating Leverage (DOL), with the nominal payment capacity, in the short term, measured by the Current Liquidity Ratio (CLR), as a signal of a firm's operational sustainability.

By using data from the standardized financial statements of 48 firms, listed on B3, distributed across six sectors of the Brazilian economy, from 2007 to 2017, the research results show significant evidence of the inverse relation, in the intersectoral dimension, between the DOL and the EBIT. For the correlation between the DOL and the FC and with the CLR, half of the sectors present a direct relation, and the other half, an inverse relation.



In the intersectoral dimension, the DOL reveals quanta between 1.48 and 2.42. Among these quanta, four sectors behave within the interval between 1 and 2, which is the reference for optimal usage of the installed capacity, while two sectors score above 2. The CLR remains comfortable in the interval between 1.84 and 2.38, being that, in the two sectors with the DOL quantum exceeding 2, the CLR is lower than the DOL. The higher/lower operational efficiency is shown in sectors PU/HC, with DOL values of 1.48/2.72, respectively.

The results of the analyses produced by the model show robust evidence that, at a full use of the installed capacity, a firm is operationally sustainable, producing a DOL in the interval between 1 and 2 and a CLR quantum higher than a DOL quantum, and, consequently, produces an OPFS quantum lower than 1. This corroborates the fact that the model's specification is adequate, as well as the fact that the lowest DOL produces the lowest OPFS, and, consequently, the highest DOL produces the highest OPFS, with both indicators therefore having a direct relation.

In conclusion, the research results are shown to be robust, and, therefore contribute to the literature for the assessment of a firm's operational sustainability. The authors hope that subsequent research will test a wide application of the model, considering that the financial industry was not contemplated due to its peculiarities and specificities.

## REFERENCES

- Assaf Neto, Alexandre. (2014). **Finanças corporativas e valor**. 7th ed. São Paulo: Atlas.
- B3 (BRASIL, Bolsa, Balcão). (2018). **Empresas Listadas**. Available at: < [http://www.b3.com.br/pt\\_br/produtos-e-servicos/negociacao/renda-variavel/empresas-listadas.htm](http://www.b3.com.br/pt_br/produtos-e-servicos/negociacao/renda-variavel/empresas-listadas.htm)>. Access on: 30 Aug. 2018.
- De França, José Antonio. (2012). **Eficiência da Firma: Compatibilização das visões da Economia e da Contabilidade**. Brasília, 2012. Thesis (PhD in Accounting Sciences) - Programa Multi-institucional e Inter-regional de Pós Graduação em Ciências Contábeis UnB/UFPB/UFRN.
- De França, José Antonio; Lustosa, Paulo Roberto Barbosa. (2011). **Eficiência e Alavancagem Operacional sob Concorrência Perfeita: uma Discussão com Base nas abordagens Contábil e Econômica**. Revista Contabilidade, Gestão e Governança, Brasília, v. 14, no. 3, p. 60-76, Sep./Dec.
- De França, José Antonio e Sandoval, Wilfredo Sosa. (2019). Necessary and Sufficient Conditions for Liquidity management. International Journal of Economics and Finance. V.11, n. 5.
- Diamond, Douglas W.; Rajan, Raghuram G. (1999). Liquidity risk, liquidity creation and financial fragility: a theory of banking. Working Paper 7430. National Bureau of Economic Research . Available at: <http://www.nber.org/papers/w7430>. Access on: 03. Jan. 2019.
- Gahlon, J.M. (1981). Operating Leverage as a Determinant of Systematic Risk. Journal of Business research, 9, 297-308.
- Garrison, Ray H.; Noreen, Eric W.; Brewer, Peter C. (2013). **Contabilidade Gerencial**. 14th ed. São Paulo: Bookman.
- Gill, Amarjit.; Mathur, Neil. (2011). Factors that influence corporate liquidity holdings in Canada. Journal of applied finance & banking. v. 1, n. 2. pp. 133-153.
- Gitman, Lawrence J. (2002). **Princípios de administração financeira**. 7th ed. São Paulo: Harbra.

- Grossman, Sanford J.; Miller, Merton H. (1988). Liquidity and market structure. Working Paper 2641. National Bureau of Economic Research. Available at: <https://www.nber.org/papers/w2641.pdf>. Access on: 03 Jan. 2019.
- Lancaster, Carol.; Stevens, Jerry L.; Jennings, Joseph A. (1998). Corporate liquidity and the significance of earnings versus cash flow. The Journal of applied Business Research. v. 14, n. 4.
- Mankiw, N. Gregory. (2009). **Introdução à Economia**. 5th ed. S o Paulo: Cengage.
- Richards, Verlyn D.; Laughlin, Eugene J. (1980). A cash conversion cycle approach to liquidity analysis. Financial Management. v. 9, r. 1, pp. 32-38.
- Spiegel, Murray Ralph. (1978). Probabilidade e Estatística. S o Paulo: McGraw-Hill.
- Stowe, John D.; Ingene, Charles A. (1984). **Microeconomic Influences on Operating Leverage**. Journal of Economics and Business, 233-241.
- Van Horne, J.C.; Wachowich, J.M. (2008). **Fundamentals of Financial Management**. 13th ed. London; Prentice Hall, Inc.

## APPENDIX

**Table A1:** Firms listed on B3 that satisfy the requirement for the completeness of the standardized financial statements – 2007:1 to 2017:4

Firm Code	Firm	Sector Code	Firm Code	Firm	Sector Code	Firm Code	Firm	Sector Code
E1	Afluente	PU	E17	Elektro	PU	E33	Multiplan	FN
E2	Ampla Energ B2W	PU	E18	Fras-Le	IG	E34	Natura	NCS
E3	Digital	CS	E19	Ger Paranap	PU	E35	Neoenergia	PU
E4	Baumer	HC	E20	Grazziotin	CS	E36	Odontoprev	HC
E5	Ceg	PU	E21	Grendene	CS	E37	Paul F Luz	PU
E6	Cemar	PU	E22	Ioehp-Maxion	CS	E38	Proman	PU
E7	Cia Hering	CS	E23	JBS	NCS	E39	RaiaDrogasil	HC
E8	Coelba	CS	E24	Josapar	NCS	E40	Randon Part	IG
E9	Coelce	PU	E25	Light S/A	PU	E41	Rio Gde Ener	PU
E10	Comgas	PU	E26	Localiza	CS	E42	Sanepar	PU
E11	Conc Rio Ter	IG	E27	Lojas Americ	CS	E43	Sanepar	PU
E12	Copasa	PU	E28	Lojas Renner	CS	E44	Schulz	IG
E13	Copel	PU	E29	M.Diasbranco	NCS	E45	Tegma	IG
E14	Cosern	PU	E30	Marfrig	NCS	E46	Uptick	PU
E15	CPFL Energia	PU	E31	Menezes Cort	FN	E47	Valid	IG
E16	Dasa	HC	E32	Minerva	NCS	E48	Weg	IG

Source: Authors and B3 (Brasil, Bolsa, Balcão, 2018).

**Table A2:** Sectors of the Brazilian economy and number of firms in the sample

Code	Sector	Description of activities	No. of firms
IG	Industrial Goods	Trade; construction and engineering; machines and equipment; transport material; transport services; and various services	7
CS	Cyclical Stocks	Construction; hotels/restaurants; fabric/clothing/footwear; automobiles/motorcycles; media; and travel/leisure.	9
NCS	Non-Cyclical Stocks	Processed foods; agriculture and livestock; drinks; trade/distribution; and personal use/cleaning products.	6
FN	Finance	Financial/real estate; financial intermediaries; pension/insurance; receivables securitizers; and various financial services.	3
HC	Healthcare	Trade/distribution of medicines and other products; healthcare-related equipment; medical/hospital services; and analysis/diagnosis.	4
PU	Public Utilities	Supply of basic need services for the general population: electricity, natural gas, sanitation, and water.	19

Source: Authors and B3 (Brasil, Bolsa, Balcão, 2018).

## **Patent Profile of the Patent Deposits of FINEP Participants with CT-Petro Resources**

### **Rosa Elaine Andrade Santos**

PhD student in Intellectual Property Science (UFS) - Graduate Program in Intellectual Property Sciences, Federal University of Sergipe (UFS)  
São Cristóvão, Sergipe, Brazil  
Administrative Technician in Education – Federal Institute of Sergipe (IFS)  
Lagarto, Sergipe, Brazil  
rosaeconomista@hotmail.com

### **Gilberto Andrade dos Santos**

Financial Analyst – UniAGES - University Center AGES  
Paripiranga, Bahia, Brazil

### **Gabriel Francisco da Silva**

PhD in Food Engineering from the State University of Campinas (UNICAMP)  
Associate Professor at the Petroleum Engineering Nucleus, Graduate Program in Intellectual Property Science and the Northeastern Network Program in Biotechnology (UFS) Federal University of Sergipe  
São Cristóvão, Sergipe, Brazil.

### **Suzana Leitão Russo**

Post-Doctorate in Technology Transfer from the University of South Florida (USA).  
Associate Professor at the Federal University of Sergipe, (UFS) Federal University of Sergipe  
São Cristóvão, Sergipe, Brazil

## **Abstract**

*This article presents the patent filing profile of the participants of CT-Petro edicts. The release of the notices and analysis of projects are in charge of FINEP, the period analyzed will be from 1998 to 2018. Since this is the oil and natural gas production chain, the general objective of the referred work is to verify if the IPC - International Patent Classification C10, was present in the deposits of the participants. As well as, among the CPI codes, the nomenclature with the highest frequency of presentation. For the robustness of the work, the historical contextualization and definition of patents, Patentometry and the International Patent Classification - IPC, adopted by the National Institute of Industrial Property - INPI, were performed. The literature review highlights the importance given to patents for technological and economic development. The methodology applied has a qualitative and quantitative character, the sample studied are the institutions that had projects approved by FINEP. In short, the article seeks to outline the profile of patents developed in the participating institutions and whether this profile will reflect positive results for CT-Petro.*

**Keywords:** Patents, Patentometry, International Classification of Patents.

## **1. Introduction**

After the creation of the CT-Petro Sectoral Fund in 1998, the program was structured and the normative structure for the release of financial resources was defined. FINEP made the first public call through a public notice to attract researchers, research institutions, universities and companies interested in strengthening the oil and natural gas production chain in the country.

Such public policy was created to minimize the performance of foreign institutions in this field in the country. To strengthen and stimulate R&D throughout the country. As well as, to stimulate regions of Brazil with a volume of research and technology developed smaller than the Southeast and South axis. Thus, the CT-Petro was divided into two macro-regions: region - Southeast and South; region - Northeast, North and Center-West. The publication of the edicts has an isonomic character allowing the participation of institutions from all regions of the country, aiming at changing the scenario of concentration in only one region (SENADO, 2016; FINEP, 2019).

In countries with good technological indicators, the relevance given the production of patents and their applicability is noted (SOUZA & ALMEIDA, 2019). The institutions participating in these edicts have the autonomy to create patents, as well as their deposit with the agency responsible for this protection in Brazil (FINEP, 2019). Based on this principle, the possibility of a patent profile for institutions participating in these public calls is investigated.

Several areas considered as national security require greater attention to their legal, economic, social and technological protection. It is notorious that even with the recent policies developed, a better perception of them is still necessary for the Brazilian society (SOUZA & ALMEIDA, 2019). Intellectual Property is included in these strategic areas.

The oil and natural gas industry includes several other industries, such as automation, transportation, steel, mechanical, naval, energy, information technology, among others (FINEP, 2019). As the objective of the work is to draw up a patent profile of the participants in the edicts and verify whether in any way the patents filed generated positive results for this economic chain, it was necessary to use the IPC to develop the research methodology (INPI, 2020).

Well, with all the development structure of the work put together, the importance of patents and Patentometry for economic and technological development was highlighted. Following a brief explanation of the international classification of patents - IPC and analysis of the patent survey conducted in the INPI database.

## **2. Literature Review**

### **2.1 Patents and Patentometry**

In Brazil, the first normative instruments referring to patent registrations date from 1809 that aimed to protect some new machine, for a period of 14 years. In 1923, the General Directorate of Industrial Property - DGPI was created, which served as a model for the creation of other structures to deal with the matter until the National Institute of Industrial Property - INPI, in 1970. In 1971, the first industrial property code was created. This code was revoked by Law no. 9,279/1996 (WIPO, 2016; SOUZA & ALMEIDA, 2019). The first international treaty on the subject was the 1883 Convention of the Union of Paris - CUP, of which

Brazil was a signatory. This convention gave subsidies for the creation of the International Secretariat of the Union for the protection of IP - BIRPI. In 1967, it underwent restructuring that resulted in the World Intellectual Property Organization - WIPO.

WIPO defined as intellectual property everything that is the result of human creation that can be industrialized, can contribute to science and, also, has a literary and/or artistic stamp.

In Brazil, Law no. 9.279/1996 provides for patents and what can be protected with their registration with the INPI, envisaging the social interest, technological and economic development of the country (BRAZIL, 1996; WIPO, 2016). In the referred law that regulates rights and obligations related to industrial property, there are subdivisions of Intellectual Property in the country, in which patents fall under Industrial Property.

*"...a patent protects an invention and grants the holder exclusive rights to use his invention for a limited period of time in a particular country" (WIPO, 2016).*

The INPI maintains on its website the main information regarding the IP modalities that can be registered, as well as manuals that the depositors need to read to meet the main requirements. Among the patentability requirements, the application for filing must contain a descriptive report, claims and a very precise summary (INPI, 2020; WIPO, 2016).

*"Patents are documents with a legal status to describe and claim technological inventions in which, similar to scientific publications, references are given. These references concern mainly earlier patents ('prior art') in order to prove novelty in view of the existing technological developments" (VAN RAAN, 2017).*

In academic articles from the most renowned scientific journals around the world it is evident that the evaluation of scientific and technological development takes place by means of intellectual property indicators, that is, the higher the volume of deposits and the faster the granting of patents, the better will be the results generated for the economy of a given country, as well as its performance in the international market (QUERIOZ, 2006; FABRIS, 2016).

In countries such as Japan, Taiwan, the United States and the European Union, the period for granting patents is very short if compared to Brazil. In the country, the average for the concession is around 10 years (SENADO, 2016).

The competitiveness between countries and companies can be measured from the patents developed, they can become parameters for economic sectors and competitive actions (LEYDEDORF, 2001). Because of this, policies to stimulate the importance of patents and the decrease in their grant term are necessary. Moura et. all. (2019) reinforce the importance of patents when they state that patenting symbolizes innovation and economic and technological development.

Cornell University, the French Business School Insead and WIPO publish annually a report called Global Innovation Index (GII) in which the innovation index of the countries stands out, the number of patent registrations compose part of the indicators used in the mentioned study (SOUZA & ALMEIDA, 2019; GII, 2020).



In recent years, within the academic environment, Patentometry has been observed, which is a metric for evaluating technologies developed through patents with a focus on gathering data that solidify the benefits of a given technology (MENDES & MELO, 2017). However, there is also a duplication in the evaluation of Patentometry, one up to patents and patent citations; another, to demonstrate innovation and technological production (OLIVEIRA et. all., 2019).

There is a concession that public and private organizations make use of methods that assess the degree of technological development, with Patentometry being a cornerstone for such analysis. Through it, it is possible to verify the potential of knowledge transformation in products and services that may reach society (MENDES & MELO, 2017; OLIVEIRA et. all, 2019).

According to Oliveira et. all. (2019), Patentometry is responsible for developing organizations and countries that can direct scientific, industrial and business policies, strengthening the relationship between University-Business-Government. The Patentometry study highlights the main trends and possibilities of partners, being an analytical method of bibliometric, that is, a metric study of patent documents (MENDES & MELO, 2017).

The edicts of CT-Petro created by *Financiadora de Estudos e Projetos - Finep* (Studies and Projects Financing Agency) question whether those projects developed with public resources generated a patent and can be inferred as a stimulus to the creation of patents (FINEP, 2019).

Mendes and Melo (2017) state that an evaluation of technology - AT is extremely important because it can be verified if the technology acquired by the institution will contribute to solve the existing demands. This evaluation can be done through the patents created and granted.

In the next topic the Patent Classification adopted by INPI will be addressed, the agency seeks to follow the international parameters to perform the analysis of what can be patented and avoid future judicial and diplomatic problems. The guidance given by the BPTO to file a patent application is that a prior art search be performed. Such search must be performed in the BPTO's database and in the main international databases, such as USPTO, LATIPAT, PATENTSCOPE® and ESPACENET.

## 2.2 Patent Classification

The International Patent Classification - IPC was created from the Strasbourg Agreement in the 1970s,

*"...has as its initial objective the establishment of an effective search tool for the retrieval of patent documents by intellectual property offices and other users in order to establish novelty and evaluate the inventive step or non-obviousness (including the evaluation of technical progress and useful results or utilities) of technical disclosures in patent applications" (WIPO, 2019, p. 1)*

The CPI is divided into main groups, being arranged into Section, Class, Subclass, Group and Complete Symbol of the classification.

The BPTO adopts the International Patent Classification (IPC) to classify its applications. Below is a table prepared with data from the IPC Classification used in Brazil.

Table 1 - Distribution of CPI Codes by Section

Section	Section Title
Section A	Human Needs
Section B	Processing Operations; Transportation
Section C	Chemistry; Metallurgy
Section D	Textiles; Paper
Section E	Fixed Constructions
Section F	Mechanical Engineering; Lighting; Heating; Weapons; Explosion
Section G	Physics
Section H	Electricity

Source: Prepared by the authors, 2020.

Within each section there are subsections with the respective codes used within CPI. The CT-Petro Sectoral Fund, as it deals with the oil and natural gas production chain, can be framed in Section C. This section is subdivided into: Chemistry, Metallurgy and Combination Technology. The distribution of the codes occurs as follows:

- Chemistry: 14 codes;
- Metallurgy: 5 codes;
- Combinatorial Technology: 2 codes.

For the present work, the analysis was carried out on the distribution of codes within the Chemical subdivision. Below in table 2 is the distribution of this subdivision.

Table 2 - Distribution of CPI Codes in Section C - Chemistry (Subsections)

Code	Classification
C01	Inorganic Chemistry
C02	Water, Wastewater, Sewage or Sludge Treatment
C03	Glass; Mineral Wool or Slag Wool
C04	Cement; Concrete; Artificial Stone; Ceramics; Refractory;
C05	Fertilizers; Its Manufacture
C06	Explosives; Matches
C07	Organic Chemistry
C08	Organic Macromolecular Compounds; Its Preparation or Chemical Processing; Same Based Compositions
C09	Dyes; Paints; Polishers; Natural Resins; Adhesives; Compositions Not Covered in Other Places; Applications of Materials Not Covered in Other Places
C10	Oil, Gas or Coke Industries; Technical Gases Containing Carbon Monoxide; Fuels; Lubricants; Peat
C11	Animal or Vegetable Oils, Fats, Fatty Substances or Waxes; Fatty

	Acids Derived from the Same; Detergents; Candles
C12	Biochemistry; Beer; Alcohol; Wine; Vinegar; Microbiology; Enzymology; Genetic or Mutation Engineering
C13	Sugar Industry
C14	Leather; Raw Leather; Depilated or Leather

Source: Prepared by the authors, 2020.

Starting from Table 2, with the Class defined we have the Subclasses and Groups. For the present work attention will be given to Class C10 which is subdivided into 10 Subclasses and consequently into Groups. Within the C10 classification, there are the following Subclasses: C10B, C10C, C10F, C10G, C10H, C10J, C10K, C10L, C10M and C10N.

### 3. Methodology

The methodological procedures applied to this work were of a qualitative and quantitative nature. Regarding the qualitative sphere, the theoretical basis for the description of patents, Patentometry (evaluation metrics) and the international classification of patents, adopted by the INPI, was sought. Starting from the contextualization, the quantitative methodological procedures applied were to prospect in the INPI database, the CNPJ of the institutions participating in the years in which there was demand for edicts from the CT-Petro Sectoral Fund. With the purpose of verifying whether the public resources released through the edicts contributed incisively to the technological development. The edicts were published from 2002 onwards. Initially, the search for patents took place on Finep's own website. Due to the fact that no satisfactory results were found, an e-mail was sent requesting the patent deposits of the participating institutions. The feedback from that institution is that such information would be provided by the law of access to information. With Excel spreadsheet, provided by Finep, containing the CNPJs, project titles, financial values released from the participants, the prospective work on the INPI database was started. The procedure was as follows: consult the CNPJ, check the number of patent filing processes, access each process in order to analyze if there was more than one CPI. After this survey, the data were organized in quantitative terms in the years in which CT-Petro notices existed. Therefore, the prospection took place around the patents granted through the field Applied Research in the database page. With the results, analyses were made, seeking to verify whether, within the list of institutions benefited with financial resources, they developed patents and, if so, whether they were granted.

### 4. Results Found

Initially, the spreadsheet provided by Finep was organized by year (this year is listed as the year of demand of Finep, i.e., the year in which CT-Petro notices were published), separating the institutions by the regions of the country, South, Southeast, North, Northeast and Center-West. Starting for the consultation of the CNPJs, in this part of the work we tried to verify the repetitions of the CNPJs throughout the years, as well as, if among the participants convinced and executors there were repetitions.

Starting the prospection at the INPI base, it was noted that some of the participants did not have patent

deposits. These were left aside for not contributing to the research. It is worth mentioning that the research was done only with the CNPJ numbers, in order to avoid bias in the research.

Thus, we observed the CPI codes used by the applicants in order to trace a profile of higher incidence of codes. When consulting each patent application, we observed how many codes were used (one, two, three, four or more), storing the information collected in order to establish the frequency in which certain codes appeared. Figure 1 shows the highest incidence using only deposits that contained a single CPI. With greater prominence in descending order for C12Q 1/68, B82B 3/00, G06F 17/18 and C12G 3/02.

Figure 1 - Incidence of the CPI Code of the Participating Institutions in the INPI Database



Source: Own authorship, with data from INPI, 2020.

The code C12Q 1/68 (19 times) is in the Biochemistry Class, in the Enzyme Measuring Process group. The code B82B 3/00 (15 times) is in the Processing Operations Class; Transport, in the group of Nano Structures formed by Individual Handling. And code C12G 3/02 (9 times) is in the Chemical Class; Metallurgy, in the Group of Measuring Process or Test involving Enzymes.



Figure 2 - Patent Profile Through the Patent Deposits



Source: Own authorship, with data from INPI, 2020.

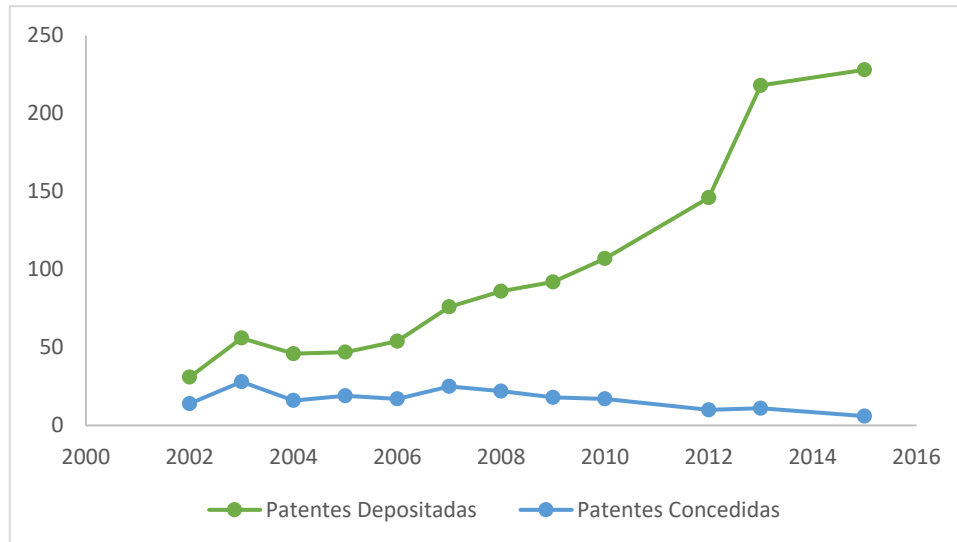
In Figure 2, the procedure was quite similar to Figure 1, the difference is that an enlargement of the sample data occurred. In this case, after prospecting at the BPTO, the first IPC code that appeared in all patent filings made by the institutions, both Convenient and Enforcement Agents participating in the edicts, was separated. The data collected were in the years of the CT-Petro demands (2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2012, 2013 and 2015), the years 2011 and 2014 were disregarded for not appearing in the spreadsheet provided by Finep. And from 2016 onwards, the 18-month grace period for deposits was disregarded as it was intended to leave a certain parameter to the participating institutions.

Well, in Figure 2, a change in the frequency of the CPI codes is noted. A61K 9/51 (76 times), followed by A61K 36/185 (42 times), C12Q 1/68 (40 times), A61K 35/644 and A61K 36/48 (both, 33 times) stand out. The code C12Q 1/68 has moved from the first position to the third. Within the IPC Classification, the A61K code is in the Human Needs Class, Preparations for Medical, Dental or Hygiene Purposes group. The C12Q code, as previously mentioned, is in the Biochemistry Class, in the Enzyme Measuring Process group.

After this analysis, it was sought to verify whether in view of the volume of deposits made by the institutions the patents were granted. The research was carried out at INPI's base, in the field Advanced Search, informing the CNPJ number (only the numbers) and marking the option Patent Granted. The procedure regarding the period was the same used in the previous figures (years of demands of the edicts), separating the convening institutions (the ones that signed the agreement) and the executors (the ones that actually executed). It became evident that part of the executing institutions were universities or research institutions, and it can even be noted that in some cases the convening and executing institutions were located in different geographic regions, inferring that there were partnerships for the development of projects. In both figures, it is noted that the curves of deposits and concessions are not close, showing that there is a need for greater incentives and public policies aimed at IP. Even with the increase in the number

of evaluators of deposit processes, the fragility of the Brazilian Patent System can be inferred. The deposits made by the institutions surveyed in the figure below increased considerably from 2010 onwards, maintaining a growing profile until 2015 (the limit year consulted).

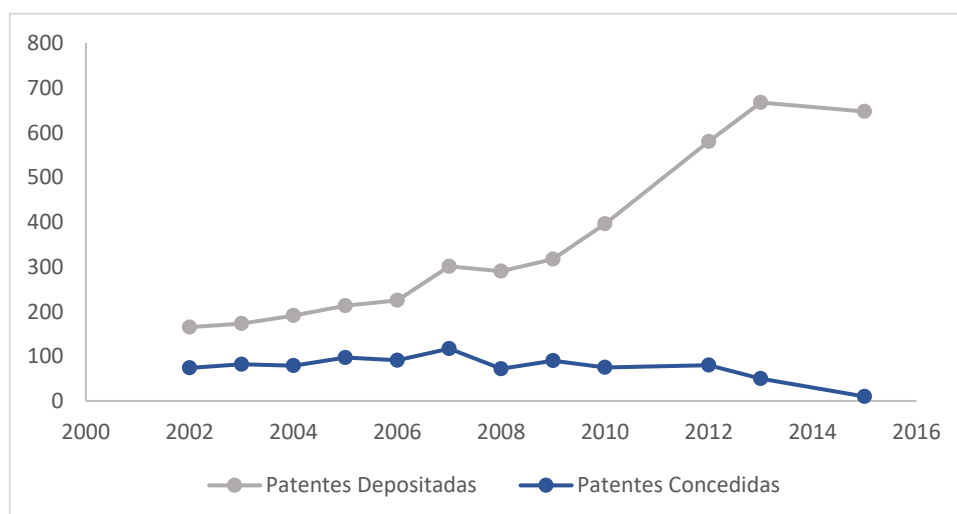
Figure 3 - Evolution of Patents Granted Versus Patents Deposited for Conventional Institutions



Source: Own authorship, with data from INPI, 2020.

However, it is observed in Figure 4 that the ascendancy of the curve within 2008 maintaining increasing until 2014 and with a small fall in 2015. In scientific articles read throughout the work on this situation in other countries, it can be concluded that if we assembled a similar graph, the trend would be that the two curves would be very close due to the simple fact that the patent structures of these countries have a greater speed in the analysis of patent applications.

Figure 4 - Evolution of Patents Granted Versus Patents Deposited for the Executing Institutions



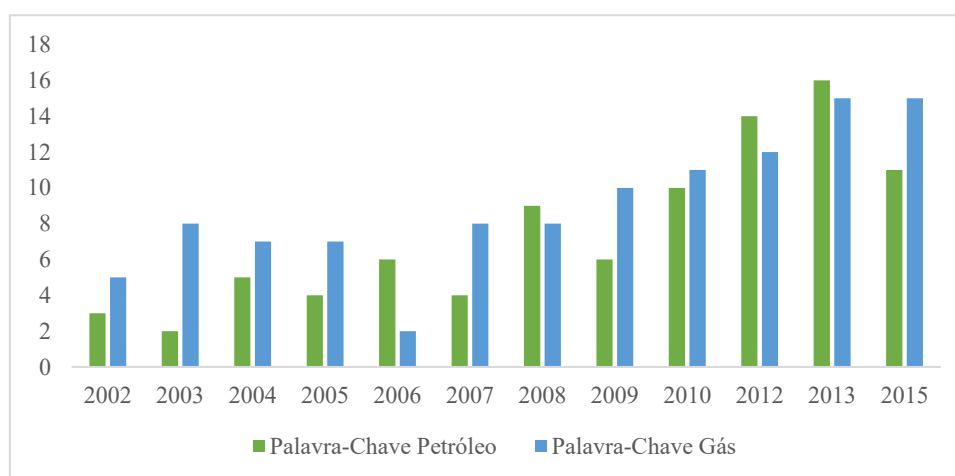
Source: Own authorship, with data from INPI, 2020.



Gas, the objective of CT-Petro. When this Sectoral Fund was created it was sought to decentralize the development of Petrobras' R&D and direct the other institutions. The aim was to stimulate the triple helix University-Government-Company. Thus, the prospective process was to separate the institutions that filed patents using IPC C10. A total of 186 patent applications using the C10 code were found, carried out by 47 institutions participating in the edicts of the CT-Petro. Among the 186 applications, 34 patents were granted in this sample containing IPC C10.

After verification by Class IPC C10, the prospective work was around the consultation by keywords "Oil" or "Gas", in the summary of the patent application document. In figure 5, the results are presented, there are not among the names researched one with greater prominence, in certain periods one stands out more than the other. It is worth noting that in the period from 2009 to 2013 the deposits in which its abstract contained the word "Gas" were increasing. Different from the results found for the word "Oil" where oscillations occur in the volume presented.

Figure 5 - Key Word Patent Deposits



Source: Own authorship, with data from INPI, 2020.

## 5. Final Considerations

With what was presented throughout the text, it can be inferred that even with the investments through the public calls of FINEP, in terms of patents, focused on the Chemistry Class; Metallurgy, the results were not encouraging. It is worth highlighting the importance of the BPTO in view of the limitations to speed up the process of evaluating patent applications, adopting the IPC, which is an international standard. However, its database still has some limitations. During the course of this work, it became evident that applications with more than one CPI are not detailed in the general list of applications per CNPJ.

It is worth noting that the C10 code, when compared with the others presented, had little representativity. The highest frequency for the codes was for the Human Needs class. During the survey of data, it is noted that only the release of financial resources for project development is not the way to expand the development of patents. Public policies to stimulate IP need to be expanded, through capacity building with those involved and partnerships between the largest patent producers in the country and those not producing patents. And that the patents developed can meet the demands of society.

## 6. References

- BRASIL. Lei nº 9.279, de 14 de maio de 1996. Regula direitos e obrigações relativos à propriedade industrial. Disponível em: [http://www.planalto.gov.br/ccivil\\_03/leis/19279.htm](http://www.planalto.gov.br/ccivil_03/leis/19279.htm). Acesso em: jun de 2019.
- FABRIS, J. P. Conexões entre Empresas e Universidades. Tese de Doutorado em Ciência da Propriedade Intelectual. Programa de Pós-Graduação em Ciência da Propriedade Intelectual. Universidade Federal de Sergipe. São Cristóvão. SE. 2016.
- FINEP - Financiadora de Estudos e Projetos. Disponível em: [www.finep.gov.br](http://www.finep.gov.br). Acesso em: mar/2019.
- GII – Global Innovation Index. Disponível em: <<http://www.globalinnovationindex.org/Home>>.
- INPI – Instituto Nacional de Propriedade Industrial. Disponível em: <http://www.inpi.gov.br/>. Acesso em: mai/2019.
- INPI – Instituto Nacional de Propriedade Industrial. Disponível em: <http://www.inpi.gov.br/>. Acesso em: mar/2020.
- LEYDESDORF, L. Indicators of innovation in a knowledgebased economy. CiberMetrics: International Journal of Scientometrics, Informetrics and Bibliometrics, v.5, n.1, 2001.
- MENDES, M. L. S.; MELO, D. R. A. de. Avaliação Tecnológica: Uma Proposta Metodológica. RAC, Rio de Janeiro, v. 21, n. 4, pp. 569-584, Julho/Agosto, 2017. Disponível em: <<http://www.anpad.org.br/rac>>
- OLIVEIRA, L. B. de, RUSSO, S. L., MARQUES, L. G. A., & GOMILA, J. M. V. (2019). Technological productivity on control of Boophilus Microplus tick: A Patentometric Study. *International Journal of Advanced Engineering Research and Science*, 6(2). Retrieved from <http://journal-repository.com/index.php/ijaers/article/view/1032>
- OMPI – Organização Mundial da Propriedade Intelectual. Curso DL101PBR – DL- 101 Curso Geral de Propriedade Intelectual – DL101PBR. 2016.
- OMPI – Organização Mundial da Propriedade Intelectual. Guide IPC Classificação. 2019.
- QUEIROZ, N. M. Os Fundos Setoriais de CT&I: o caso do CT-Petro e sua execução pelo CNPq. Dissertação de Mestrado. Centro de Desenvolvimento Sustentável. Universidade de Brasília. Brasília. DF. 2006. Disponível em: <http://repositorio.unb.br/handle/10482/4771>
- SENADO. Relatório CCT – Avaliação de Políticas Públicas. Comissão de Ciência, Tecnologia, Inovação, Comunicação e Informática. Fundos de Incentivo ao Desenvolvimento Tecnológico. Brasília. DF. 2016. Disponível em: <http://legis.senado.leg.br/comissoes/comissao;jsessionid=40CC56D0FEB47563FD0AB66BB0EF48CC?0&codcol=1363>. Acesso em: mar/abr 2019.
- SOUZA, N. V. de; ALMEIDA, N. N. de. As Patentes no Cenário Brasileiro e a Necessidade de Políticas Públicas para Aumento do Número de Registros Patentários no Âmbito da Defesa. *Revista Brasileira de Estudos Estratégicos*. Instituto de Estudos Estratégicos – UFF. v. 11, n. 21, p. 37-69. 2019.
- VAN RAAN, A.F.J. Sleeping beauties cited in patents: Is there also a dormitory of inventions?. *Scientometrics* **110**, 1123–1156 (2017). <https://doi.org/10.1007/s11192-016-2215-8>

## Copyright Disclaimer

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

# **Shattering Ethnocentric and Eurocentric Subjectivities in foreign language teaching: A Critical Intercultural Perspective**

**Adriana Carolina Torres Escobar**

English, French and Spanish Professor

Education Faculty, Ph.D. program in Education, Universidad Santo Tomás, Bogotá, 110111, Colombia

Corresponding Author: [adrianatorrese@ustadistancia.edu.co](mailto:adrianatorrese@ustadistancia.edu.co)

## **Abstract**

*The complexity and essence of languages and cultures are unique. People live in culturally built niches based on beliefs, subjectivities, skills, and practices resulting from symbolic and material inheritances passed down from generation to generation. Throughout the qualitative, documentary, and hermeneutical research, it has been feasible to identify that postmodern society has reified human beings. People are considered a means of production and consumption. Besides, the dominant groups impose languages and cultures that they label as prestigious, ignoring that every person is unique and has ideas, values, religions, languages, and cultures. This article will describe the process of subjectivation and its relationship with 'technologies of power,' which enforce thoughts, self-concept, and behavior abstractly, subtly, and invisibly. The results depict that some authors define the English language as dominant, imperialistic, and homogeneous. The article goes further than this intellectual elaboration. It proposes that educational institutions should be sites where students actively adopt an intercultural, analytical, and critical thinking approach to learning foreign languages. That way, students learn to discover their identities, value pluralism, research the causes and consequences of domination methods, and are open to diversity without acquiring ethnocentrism or xenophobic ideologies. The article contests neutrality and dogmatism in education. It defines schools as cultural and political arenas where teachers should support students to understand reality, generate argumentative competencies and use them to make rich proposals on crucial topics for humanity, building a more democratic and proactive society. Thinking about education from a humanistic and ethical approach and holding transformative social action in classrooms respond to the chaotic and uneven prevailing world.*

**Keywords:** culture, ethnocentrism, eurocentrism, English, identity, interculturality, postmodernity, power, subjectivity.

## **1. Introduction**

The term postmodernity was born with Jean-François Lyotard as the skepticism of the masses towards metanarratives. Before that period, there were central principles of rational progress and universal truths. In postmodernity, facts are debatable. There are relativized values, contingent patterns of behavior, ceaseless changes, and unpredictable situations. Currently, the masses believe that there are multiple

options available to choose from in terms of families' structure, religions, lifestyles, and relationships. What really matters in the postmodern society is accomplishing a state of bliss, indulgence, and the feeling of freedom even though it is fallacious in most cases. In fact, the contemporary world is rife with surveillance, materialism, and chaotic lives.

Currently, people's competence to turn data into information has weakened. The concept of knowledge reduces to coded messages flowing within the communication system. Regarding this upshot, Soto Urrea (2009) points out that, in postmodernity, communication is perceived as something stringently physical, quantitative, and statistical and not as a process of analysis that builds organized, reflexive and structured information and knowledge. This cognition proves that the knowledge mission has shifted from the ends of human welfare to its means. It entails the pragmatics of communication through 'the agents of power' who dominate the media and spread messages loaded with ideologies that meet the elites' interests and the market. It happens in all aspects of life. For instance, according to Lyotard (1984), STEAM fields, what is taught, what is researched, and what is published, depend on governments' decisions because they are the sponsors. Thus, they decide to reject or bolster initiatives and research through normativity, media, and funds.

People live in a hectic routine, and most of them find it hard to discern the truth. Therefore, the 'technologies of power' have control of their minds, decisions, and actions. The masses are solely playing the role of consumers, and they are surrendered to the ideas that the media implants on them.

Currently, people have access to countless data and news without reaching an in-depth and holistic vision because, as Lyotard (1984) points out, 'the agents of power' have vanished epistemic coherence. Consequently, fragmentation of knowledge and abrupt changes make people not be studious and reflective. They lose meaning, are unstable, and do not use their 'technologies of the self' to build deliberate subjectivities that lead to a strong identity.

Subjectivity refers to human subjects' constitution, which results from experiences, discourses, forms of knowledge, and contexts. According to Foucault (1975), the subject has died in postmodernity and is merely a power discourse product, being socially constructed. The discourse has specific intentions and is historically situated. The process of subjectivation consists of the subjects acquiescing to the power devices that shape them as disciplinary individuals. 'Technologies of power' are used to articulate domination and discipline techniques to exert mental power over individuals to make them reproduce thoughts, ideologies, decisions, and resolutions without them even noticing that they are being fabricated externally. Subjects can escape from this domination through 'technologies of the self,' which are techniques devised to consciously form, conserve, or transform their identity according to ethical relationships. When the subjects develop and use the 'technologies of the self,' they accomplish the goal of governing themselves purposely, exploring their insights about the world and their relationships to appraise causes and outgrowths, as well as taking care of themselves and those around them (Foucault, 1982).

Technical performativity maximizes information flow and minimizes static procedures that are not economically profitable for the system. For this purpose, the 'technologies of power' appear. These are the discursive techniques and tactics that elites use to subtly rule citizens, organize their lives, and produce subjectivities and actions through discursive relationships (Foucault, 1982). Organizations, governments, corporations, and elites use language to disseminate discourses that void the relevance of everything that

does not make a profit. After several repetitions, people end up believing in the certainty of these contents. In this vein, society is prone to reproduce subjectivities that yield to hegemonic and bureaucratic impositions.

'Critical interculturality' defeats dominance, struggling against foreground subalternation models and hierarchization (Anzaldúa, 1987; Gutiérrez, 2008; Kramsch, 1993). According to Walsh (2010), there are three main definitions of interculturality. Relational interculturality is reductionist because even though it declares the prominence of the exchange among cultures, it still maintains discrimination. Functional interculturality is hegemonic because the governments plan to homogenize the population, whereby the uniformization of normativity voids inclusion. In reality, it invalidates diversity and pluralism's richness. Eventually, 'critical interculturality' is how this article defines interculturality. It is decolonial and ethical because it intends to struggle inequality through a socio-historic transformation whose purpose is to defend, dignify and preserve the diversity of identities, cultures, languages, subjectivities, social relationships, beliefs, and institutions. In this process, there are no attempts to either colonize the ideas, thoughts, and selves of the people or homogenize, judge, and despise what is different from the 'normality.' 'Critical interculturality' embraces diversity; it is not ethnocentric and does not promote the subjectivity that foreign languages contaminate nations' purity. Interculturality consists of listening to the dominant and oppressed communities and individuals from a critical outlook that explores causes, stories, current situations, and delves into conclusions, positions, and experiences. Plus, it weaves relationships between languages, cultures, history, and realities.

## **2. Methodology**

Macdonald & Tipton (1993) state that documentary research provides depth to the data, details, interpretative variety, and contextualization to the researcher's findings. The study was qualitative, documentary, and hermeneutical. The design was non-experimental and descriptive. The researcher organized the information taking into account formal elements such as author, title, publisher, name of the document source, year of publication, description of the content, and analysis. Evaluating what Gadamer (2004) and Lincoln & Guba (1985) point out about interpretation, this research analyzed and interpreted documents to have a global and comprehensive perspective. The study conducted a thorough interrogation of the texts to unravel their arguments. The researcher inquired the texts to critically analyze subjectivities about linguistic and cultural perspectives, language, and power, taking into account her academic path and expertise in teaching foreign languages and interculturality. There was a construction of concepts inside the information, the interpretation, the context, the theory, and critical thinking. The exploration was beneficial for answering the following questions:

1. How are the subjectivities of researchers diminishing the significance of teaching foreign languages?
2. How can students learn English and other foreign languages without losing their identities?
3. How does 'critical interculturality' impact on the teaching of foreign languages?

## **3. Results**

According to Phillipson (2012), teaching English as an international and superior language is defined as

'linguistic imperialism,' which is an expression of discrimination and narrow-mindedness. There is a unique language's preeminence over others equally important, including local, indigenous or foreign languages. The English language has gained a privileged position, which makes it especially appraised. Indeed, the domination of English in education has become a means to promote western ideologies. Unconsciously, societies adopt the subjectivity that the English language is more valuable than any other because it bestows power, status, and wealth.

Consequently, governments worldwide dispense more publicity, laws, resources, and infrastructure to promote the English language, although every country has various tongues. Envisioning favoritism towards foreign languages creates an atmosphere of inequality and social injustice, the disappearance of minority languages, and the communities to which they belong. Indeed, learning the language with the highest hierarchy has become one of the axes of education. Subconsciously, it means being part of an influential civilization. As Canagarajah (1999) and Pennycook (1998) mention, it takes a colonial character. Language is one of the most potent instruments of domination. Languages are alive, and they are used to spread cultures, lifestyles, economic and political ideologies that nonnative countries try to follow to be successful. A way in which people massify and hierarchize is through languages. In response to that, nonnative English speakers who have learned it outnumber English native speakers 3 to 1 (Crystal, 2003). The linguistic imperialism of English predominates in the postmodern era, and at an overall level, it helps to maintain prevailing power relations among speakers. Hence, globally, English is the most respected, legitimate, and influential in social, academic, political, and business spheres. Holliday (2005) has criticized the pervasive ideology that privileges English speakers and marginalizes individuals who do not have English proficiency, which deprives the significance of plurality.

Brown (2007), Crystal (2003), Galloway & Rose (2018), Halliday (2003), Harmer (2007), Jenkins (2007), Seidlhofer (2005), Steger (2009) are authors that label English as the global language communication, the internationally most widely used language and the vehicle for information and knowledge. In this same sense, Xu (2018) characterizes it as an extensive native language and a supreme language. English is a multicultural way of thinking, doing, and being.

Nunan (2015) describes some examples of the predominance that English has taken worldwide:

1. In Latin America, some companies such as KPMG have resolved that English is the official language of communication within the corporation.
2. In Thailand, English was the language used for Chinese and Thai engineers to build a dam.
3. In the Philippines, the Pope addresses the faithful in English.
4. In southern China, a Hong Kong accounting firm conducts its audit, collecting the data in Mandarin and Cantonese, but submits the report using the English language.
5. In Brazil, a leading agricultural export company hires only English-proficient employees and trains them as accountants, rather than hiring accountants and training them in English.
6. In Korea, several top universities mandate English as the medium of instruction in technology and engineering.

The rapid expansion of teaching English to students in many countries around the world has been, at a great extension, an educational response to demands in the job market. English stands out as an essential language through worldwide state policies because it is a means of social mobility and synonymous with



earnings. This utilitarian conception that society and governments have assigned to this language is part of the neoliberal discourse of linguistic capital in the globalized economy that associates English as a device to thrive in the market, access opportunities, and banish the less competent (Canagarajah, 2017).

In Colombia, Chile, Costa Rica, Ecuador, Mexico, Panama (Cronquist & Fiszbein, 2017), China (Qi, 2016), and Japan (Liang, 2017), among other countries, English is a compulsory subject of the curriculum. Governments have used normativity to establish that schools and universities teach English as a foreign language, overlooking other foreign languages and even lowering priority to ancestral languages. These last ones should be defended and conveyed from generation to generation to preserve cultural identity and linguistic variety. In Singapore, Malaysia, and India, the governments have been remarkably emphatic on demanding students and workers a fluent English language to access the most reputable universities and the highest salary jobs. Therefore, countless citizens study English until it becomes the language in which they are most knowledgeable and more fluent, even in detriment of their native languages.

Consequently, these countries have experienced a sharp decrease in the mastery of their country's native tongues. Part of the population feels an aversion to individuals who know and use the native languages. Thus, they avoid teaching other languages than English to their children (Liang, 2017). Therefore, the transmission from one generation to the next is broken.

These factors drive an economic and political advantage to the dominant English-speaking countries. Galloway & Rose (2018) criticize the imperialism of English as a policy that benefits this language over others and represents diverse linguistic communities as inferior, mediocre, and weak. With the expansion of English-speaking nations into non-English speaking regions, people who achieve better command of the language are perceived as more competitive and have entrance to various academic and job opportunities. According to Butler et al. (2018), the English language has spread at the expense of native languages, and societies have idealized it as the language that makes business, learning, and communication possible since English skills are associated with social and economic growth and a modern self-image.

Regarding Colombia, Zwisler (2018) points out that there is an identity crisis in this country because the Ministry of Education has relegated Spanish and aboriginal languages to a position of social inferiority compared to English. Responding to globalization, the Colombian government tries to align economically with the capitalist English-speaking countries, and for this, it applies different strategies to make its citizens speak English. The government does not struggle to boost indigenous languages with the same eagerness as English learning. The cost that Colombia is paying to partake in the global market is the devaluation of ancestral linguistic identities.

The inordinate emphasis and overvaluation of English in Colombia and the world is startling, markedly considering that 2 500 languages are at risk of disappearance. Governments are not acting proactively to protect them. Unfortunately, it is a phenomenon that is on the rise. There are 7 000 languages globally, and 96% of the population speaks only 4% of them (Romaine, 2017). The Office of the United Nations High Commissioner for Human Rights (2019) points out that 40% of languages will vanish during this century. Likewise, in Latin America and the Caribbean, one in five indigenous people has already lost the native language. Forty-four countries in the region have replaced it with Spanish and 55 with Portuguese. The disappearance of languages threatens people's sense of identity because the transmission of values, stories, rituals, beliefs, food recipes, ancient medicine, ways of expressing emotions, humor, and unique cultural

practices also perish. Valuing and defending languages and cultures protects part of humanity's heritage, admiration for oneself and others, peaceful coexistence, collective memory, and the sense of belonging. In the specific case of Bogotá, capital of Colombia, Méndez et al. (2020) point out that the way of thinking of the bilingual subject as one who speaks English, and no other tongues, has transcended public policy campaigns. Moreover, the media's advertising has affected citizens' subjectivities, configuring the English language's supremacy as a regime of truth. On the other hand, society judges the Colombian English teachers as subjects with deficiencies and stunted effectiveness in teaching the language. These same authors illustrate that announcements build citizens' subjectivities that exacerbate English superiority and Colombian English teachers' image as inadequate personnel that cannot work efficiently and autonomously. Media discredit Colombian English teachers through negative headlines, content, and memes; sell a positive image of the native English speaking teacher while they blame Colombian English teachers because of Colombia's low English level. In contrast, Media do not evaluate the role of institutions such as the Ministry of Education, the diversity of Colombia's contexts and students, the importance of preserving other languages, the students' interests, and the scarcity of resources that are accessible in the schools to teach English.

In Colombia, several investigations affirm that organizations such as the British Council and the Cambridge University Press have furthered the teaching of English to benefit economically and attain their neoliberal goals (García et al. 2007; González 2009; Le Gal, 2018; Méndez et al. 2019). The English language teaching and learning business is an essential pillar of the British economy as it is a global product sold on the international market. The Ministry of National Education from Colombia has delegated to foreign organisms the design of curricular guidelines and materials, the administration of standardized exams to measure English, the leadership of training programs, and English immersion for students and teachers.

When considering migrants in English-speaking countries, the English language's command is an unfailingly requisite to survive, study, and work, so English superimposes on the tongues of migrant groups. The investigations of Al-Jumaily (2015); Román et al. (2019); and Velázquez (2018) agree that, in these countries, it is usual for migrant families to decide to teach English to the new generations as their mother tongue. Some immigrants get ashamed of their native languages and prefer to use English in all contexts, and children have few opportunities to learn or practice their parents' language. Besides, the population that does not speak English fluently endures negative peer pressure, social discrimination, and a decontextualized curriculum at school that does not consider the newcomers' multiple origins. Language inherently encompasses cultural elements, but parents do not transmit either of them to their children. Furthermore, many of the explicit or hidden cultural concepts embedded in English teaching materials and the media affect the children's attitudes towards their culture and identity. This generation is the result of Western civilization, which overwhelms them through language, which, according to Vygotsky (1978), is the central mediation in socio-cultural and psychological development.

How English is privileged in education systems and the discourses that justify, it needs critical scrutiny. Policies that strengthen linguistic diversity are required to counter linguistic imperialism and recognize indigenous languages. It is essential to preserve all languages because they create culture, preferences, and interpersonal relationships. For Foucault (1982), language plays a central role in the subject's decisions regarding 'technologies of power.' Bakhtin (1990) argues that language has a direct link with cultural and

social relations. From a psychoanalytic perspective, Lacan (1997) asserts that language structures a large part of subjectivity construction. In the philosophy of language, Derrida (1967) shows the transcendence of language in people's perception of meaning. In sociolinguistics, Halliday's (1978) concept of language as a social semiotic is particularly relevant for establishing a connection between socio-cultural structures and language forms.

When living with others, some people's target is to adjust to the socio-cultural context in which they move and partake in similar ideals. Therefore, they are prone to reproduce behavior patterns and repudiate those that are part of themselves but are different from the 'normality.' In these terms, the hegemonic image of the world that defines English as an outstanding language with great fame and notoriety influences how they deal with their cultural inheritance. Sometimes, if they want to be considered bilingual, appear well educated, or stand out as well-educated, they would prefer to learn English as a foreign language while discarding other tongues. This circumstance generates linguistic tension. For example, if students are bilingual and master their ancestors' languages, they may stop speaking them even in their familiar surroundings because the Western positions disregard them. Thus, the general population cannot explore other languages and cultures apart from English, even though there are more than 7000 languages worldwide (Coupé et al., 2019).

#### **4. Discussion**

In postmodernity, human beings' are treated as masses that must serve the scientific-economic progress. Mercantilism and uncaring consumerism sell deluded freedom to society. Discourses are made to dominate the masses' minds and spirits to fulfill the interests of concentrations of economic power. Eloquent speeches and alluring images intend to homogenize and make everyone think, act, and speak equivalently, to the point that learning English is also inflicted at school without offering various options. Countries have dismissed the value of the diversity of languages and cultures. They advocate that the English language is crucial because it facilitates their leadership in science, education, business, and technology. Throughout the excessive promotion of this language, inequality appears and puts other languages, plus the countries' mother tongues, at stake.

The masses look down on those who do not adhere to their lifestyles, beliefs, and expectations and mark them as backward. In 'the society of control,' individuals are always fluctuating according to the precepts of the 'technologies of power.' They reproduce patterns and do not accept heterogeneity (Soto Urrea, 2013, p. 124). Therefore, there is little admiration for indigenous people, Afro-descendants, other ethnic groups, languages, traditions, religions, and cultures, and in a demeaning manner, society deems them as periphery communities. As UNESCO (2003) states, each language possesses unique wisdom and is an essential resource for shaping identities and cultures. Indeed, the languages are the expression of who the individuals and communities are.

When educators use traditional methods of teaching foreign languages and only focus on textbook-based instruction whose emphasis is grammar, recitation, imitation, drills, and the idealization of the implications of speaking English fluently, they neglect the exploration of local and international cultures and ideologies. Owing to this situation, they keep playing a passive and sterile role to deter ethnocentric and hegemonic

forces' influences. In the 21 century, teachers' pedagogical discourses and practices should stimulate the recognition of students' own and external languages and cultures, encouraging evenhandedness and production of proposals attempting to construct democratic societies. Furthermore, teachers should introduce activities to disclose the relationships and power struggles between different economic, political, and social models. They should make students research the social relationships surrounding cultures, languages, and communities so that they realize the world's dynamics, become proactive, propose solutions and structured procedures, learn to live harmoniously, and eliminate ethnocentrism, bigotry, and discrimination.

Ethnocentrism leads individuals to be hostile and generate attitudes of fear, contempt, strangeness, hatred, and violent confrontation, either through words or actions. Fostering interculturality allows students to see the world through their own eyes and also through the eyes of others, without distorting or manipulating realities but rather judging them with reasons and arguments fairly and objectively. The English language or other languages are not perils. Indeed, linguistic and cultural diversity constitute irreplaceable wealth. When students learn new languages and cultures, they recognize the value of their identity, culture, and language and discover that they are not isolated in the world, and they are not the center. For this reason, teachers should foster activities in which students reflect on and value their origins and those of others.

Learning English is of great importance in today's globalized world. However, to go beyond the instrumentalization of language and linguistic imperialism, students must learn foreign languages through critical and non-idealizing thinking. Schools should be promoters of critical dialogue, deepening, and interpretation of realities. Horizontality and reflection on the world's facts and its current and future challenges are crucial in the classes. Learning foreign languages in this way contributes to the gain of more welcoming and positive attitudes and becomes a good platform for cultural and intercultural training.

Globalization and the learning of English is an opportunity to transcend from plurality - the recognition of diversity within society - and multiculturalism - the recognition of diversity as an essential element in society that must be respected-, to interculturality- the understanding of themselves and others in a constant ethical dialogue, interpretation, questioning, decoding, examination, interconnection, and diversity. Then, interculturality does not limit a language and culture's integrity to dances or folklore, the accentuation of stereotypes, or the attempt to change others' identities to fit in a community; indeed, it goes deeper. Interculturality exalts self-respect and deference for others. The relational and emotional component of learning is taken into account, delves into self-training and exchange of ideas as a mechanism to find differences, similarities, and complements, enriching all the subjects involved. In this order of ideas, all languages, both indigenous and foreign, are essential and have historical, social, and cultural value.

Each language's cultural aspects are critical because each society's cultural heritage relates to its language evolution. The class of foreign languages is a socio-pedagogical space. It is essential to highlight the socio-cultural aspects to bolster an intercultural dialogue that fosters a new way of looking at the world. Therefore, languages transmit personal and social actions. Consequently, it is necessary to incorporate socio-cultural factors in the language learning-teaching process.

It is of paramount importance to turn to interculturality as a means of interaction, exchange, openness, and solidarity in which values, ways of life, and symbolic representations recuperate their significance. Interculturality goes beyond the fact that several ethnic groups coexist concurrently in the same territory

but actively seek reciprocity, communication, and solidarity within different ways of understanding life, conditions, history, and social behaviors. Interculturality explores the relationships between countries, social classes, ethnic groups, and diverse contexts. Moreover, it fights against discourses and actions that spur tensions on individuals or create and intensify adverse and undemocratic relationships. Interculturality seeks to scrutinize why people stigmatize themselves and others. It also explores the consequences of constructing these subjectivities.

This research recommends that teachers expose students to social matters and address cultural and linguistic imperialism. For instance, while students are learning English, teachers can harness this language to make students explore and socialize their origins, thoughts, and personal stories. Likewise, educators should propose research tasks about the ethnic minorities of the students' country, as well as those of foreign territories.

Schools should be open-thinking environments where students cultivate an interest in searching their roots, knowing those of others, reaching out to minorities, studying other social, sexual, and religious groups, fostering responsibility to protect languages, and improving critical thinking (Leuridan, 2019). Linguistic and cultural imperialism lacks ethical foundations in favor of democratization. That practice subjugates linguistic minorities and economically vulnerable groups. Therefore, the dominant groups reinforce cultural identities, lifestyles, and methods by undermining the languages, cultures, identities, and the dignity of the most impoverished and most dependent communities.

This research suggests that the schools' priority is to help students build their identities, recognize and value their linguistic and cultural roots without being nationalistic or negatively judge the international contexts, languages, and cultures. Schools should invite aboriginal, indigenous, afro-descendants, American, Antarctic, European, African, Oceanian, and Asian people so that the students ask questions, establish dialogues, share about their identities and learn about others, discuss rituals, gastronomy, religious ceremonies, challenges, histories, and stories. As a result of this exercise, students encounter the pleasure of making introspection and plentiful intercultural interactions and relationships. This way, they fortify concrete bases to build their identity and life project eliminating the myopic vision that considers the local and autochthonous as underdeveloped, ordinary, and worthless. Students learn not to judge themselves or others because of their language, race, customs, nationality, quirks, creeds, and phenotypic characteristics. On the contrary, they strengthen their identity, accept and appreciate themselves and their fellows as worthy individuals, and find unity in the diversity without changing themselves or compelling others to change with the meaningless purpose of following fashions or socioeconomic groups.

Education focused on humanism and the defense of human rights, according to Nussbaum (2011), makes it possible to develop the capacities to decolonize and dignify people so that they feel empowered to express, respect themselves, and preserve their identity. Schools should encourage that students recognize no language or culture inferior or superior through creative, analytical, reflective, and critical thinking. When students approach their learning of English with love, disposition, and at the same time, use critical competencies, they can open an ethical conception of the world and languages. They could feel encouraged to learn not only English and its cultures but also other languages. In this way, the idealization and apprehensions towards English would diminish. In fact, they learn to appreciate their language, seek to preserve it, and not want to get rid of it. Therefore, they would pave the way to have a decolonized mind.



Learning English should not be conceived as a disruptive and harmful element. Schools should not be restricted to teach the formal content of the language. They should teach about its history, culture, idiosyncrasies, worldview, challenges, political systems, economy, and lifestyles. As a result, students have the chance to make contrasts among their identities and those of others, their realities, and foreign ones. English has the same value as native languages and has the right not to be judged, segregated, and encumbered with contempt. No language is inherently harmful or dominant. It depends on how it is socialized, taught, and learned. The English class can become a vehicle that mobilizes insights, skills, cooperation, collective consciousness, and debates beyond the linguistic, instrumental, semantic, formal, or pragmatic language content.

If schools follow the strategies proposed in this discussion, the results are favorable because students develop cultural, cognitive, and practical tools to:

1. ascertain reasons that defend the intergenerational transmission of languages and cultures considering that their loss constitutes irreplaceable damage to human cultural diversity, essence, sense of belonging, art, dignity, spirituality, contributions, and ways of being and feeling.
2. apprehend their identities, territories, traditions, families, languages, and cultures.
3. recognize that learning the languages of their country and the variety of languages that exist in the world is worthy, and English is just one of the options they can choose to learn.
4. acknowledge that they can open up to new worlds, which does not mean that their own identity should be suppressed and annulled.
5. Be tolerant of other people, languages, and cultures. Establish interpersonal relationships appreciating diversity, strengthening their identities, and eradicating subjectivities consisting of qualifying that some languages are adverse or ideal.
6. recognize the richness of the autochthonous and foreign, so necessary to build a society that evolves in the destruction of prejudices, bias, and discrimination.
7. be analytical, investigate, identify problems, be proactive in the quest for solutions.
8. discern the mechanisms that the 'technologies of power' have used to dominate the masses.

## **5. Conclusion**

An inherent part of human beings is the language because it is the core of culture and nurtures their essence. Weaving relationships with other people through language, culture, and identity unite them and make them more sensitive to others. All teachers, and not only English teachers, should rescue the value of the students' mother tongues and their territories of origin since every language contains subjectivities accumulated over millennia, which are part of human beings' sense. Students should maintain their ethnic identity and have convictions to explain, argue, keep social cohesion, and loyalty to their principles and communities. Schools must be influential in helping their students preserve their culture and the sense of belonging, commitment, and cooperation. One of the school's missions is to awaken students' awareness of the consequences of languages' death and the risks of manipulation, repression, and cultural oppression created by replacing their language's functions with other languages. When a language dies, so does its link to the cultural and historical past. Without connecting to their linguistic and cultural history, people succumb to



subjectivation, which is a worrying situation in the present postmodern era. It is necessary to guide the students to discover their mother tongues' beauty and the diversity of ethnic groups, know them and appreciate them. All this does not suggest a position against the teaching of English but rather highlights that every language, even when it is not the most popular in society and business, has a place of honor and is crucial because it comprises stories, songs, dances, rituals, family histories, bonds, and conventions. Those components, stored in the language, are invaluable and irretrievable sources that should not get extinct.

Some individuals perceive foreign people and languages as invaders that strive to dominate them, nullify their culture, and violate their moral values. Nonetheless, it is not feasible for the population to reduce their vision and keenness solely to their ethnicity and culture within this global and plural world. Ethnocentrism is harmful because it represents people who do not belong to their ethnic groups and country as 'others,' 'odds,' 'dubious,' 'strangers,' 'subversives.' Schools should not elevate ethnocentrism because it prompts students to exclusively value their achievements and particularities but exclusively loathe virtue in people of different cultures and nations. Students should not fall into violent nationalism, classism, or racism, since this process consists of marginalizing, excluding, and discriminating those who do not share their linguistic, cultural, religious, and phenotypic characteristics.

As it was possible to deduce in the research results, societies' use of the English language on profuse occasions has been instrumental. The English language is not imperialistic and colonial by itself. Admittedly, no language has an intrinsically nefarious nature. Teachers should support critical reflection and make students question various beliefs and values. That way, students nurture their cognition and intercultural sensitivity. They become the agents of their lives and political actors capable of making personal and social changes through praxis, that is to say, the combination between theory and informed decisions that transcend to reality. This mechanism is meaningful for students because they learn to maintain and enrich their identity in a reflective practice that explores the world. They learn from others, inquire, and socialize their subjectivities without acculturating or making that their identity or that of others perish. Teachers should use the English language as an opportunity of addressing social problems, delve into them, discuss them, and allow students to know the realities and make decisions. In this way, students do not take a stigmatizing ideological stance but instead decide to learn English or other languages with self-awareness and critical thinking.

## 6. References

- Al-Jumaily, S. (2015). Parents' First Language is Their Children's Second Language. Language Loss: Arabic is a Case. *International Journal of English Language Teaching*, 2(2). <https://doi.org/10.5430/ijelt.v2n2p19>
- Anzaldúa, G. (1987). *Borderlands. The New Mestiza*. Spinsters Aunt Lute.
- Bakhtin, M. (1990). *Art and answerability: Early philosophical essays*. University of Texas Press.
- Brown, H. D. (2007). *Principles of Language Learning and Teaching*. Addison Wesley Longman.
- Butler, Y. G., Sayer, P., & Huang, B. (2018). Introduction: Social class/socioeconomic status and young learners of English as a global language. *System*, 73, 1-3. <https://doi.org/10.1016/j.system.2018.02.007>

- Canagarajah, A. S. (1999). *Resisting linguistic imperialism in English teaching*. Oxford University Press.
- Canagarajah, S. A. (2017). *The Routledge handbook of migration and language*. Routledge.
- Coupé, C., Mi Oh, Y., Dediu, D., & Pellegrino, F. (2019). Different languages, similar encoding efficiency: Comparable information rates across the human communicative niche. *Science Advances*, 5(9), 1-10. <https://doi.org/10.1126/sciadv.aaw2594>
- Cronquist, K., & Fiszbein, A. (2017). *El aprendizaje del inglés en América Latina. El diálogo. Liderazgo para las Américas. [Learning English in Latin America. The dialogue. Leadership for the Americas]*. <https://www.thedialogue.org/wp-content/uploads/2017/09/El-aprendizaje-del-ingl%C3%A9s-en-Am%C3%A9rica-Latina-1.pdf>
- Crystal, D. (2003). *English as a global language* (2<sup>a</sup>. ed.). Cambridge University Press.
- Derrida, J. (1967). *De la grammatologie*. [Of grammatology]. Minuit.
- Foucault, M. (1975). *Surveiller et Punir: Naissance de la prison*. [Discipline and Punish: *The Birth of the Prison*]. Gallimard.
- Foucault, M. (1982). *La hermenéutica del sujeto. [The hermeneutics of the subject]*. Fondo de cultura Económica.
- Gadamer, H.-G. (2004). *Truth and Method* (J. Weinsheimer & D.G. Marshall, Transl., 2<sup>a</sup>. ed.). Continuum.
- Galloway, N., & Rose, H. (2018). Incorporating Global Englishes into the ELT classroom. *ELT Journal*, 72(1), 3-14. <https://doi.org/10.1093/elt/ccx010>
- García, R., Alvarez, V., López, A., Patiño, B., & Saldarriaga, R. (2007). *Legado de una Amistad*. [Legacy of a Friendship]. Centro Colombo Americano.
- González, A. (2009). On alternative and additional certifications in English language teaching. The case of Colombian EFL teachers' professional development. *Íkala, Revista de Lenguaje y Cultura*, 14 (22), 183-209. [http://www.scielo.org.co/scielo.php?script=sci\\_arttext&pid=S0123-34322009000200008&lng=en&tlng=en](http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0123-34322009000200008&lng=en&tlng=en)
- Gutiérrez, K. (2008). Developing a Socio-critical Literacy in the Third Space. In *Reading Research Quarterly*, 43(2), 148-164. <https://doi.org/10.1598/RRQ.43.2>
- Halliday, M. A. K. (1978). *Language as Social Semiotic. The social interpretation of language and meaning*. Hodder Arnold.
- Halliday, M. A. K. (2003). *Written Language, Standard Language, Global Language. World Englishes*, 22(4), 405-418. <https://doi.org/10.1002/9780470757598.ch20>
- Harmer, J. (2007). *The practice of English language teaching* (4<sup>a</sup>. ed.). Pearson Education.
- Holliday, A. (2005). *The struggle to teach English as an international language*. Oxford University Press.
- Jenkins, J. (2007). *English as a lingua franca: Attitude and identity*. Oxford University Press.
- Kramsch, C. (1993). *Context and Culture in Second Language Teaching*. Oxford University Press.
- Lacan, J. (1997). *The Language of the Self: The Function of Language in Psychoanalysis* (A. Wilden, Transl.). The Johns Hopkins University Press.
- Le Gal, D. (2018). English Language Teaching in Colombia: A Necessary Paradigm Shift. *Matices en Lenguas Extranjeras*, (12), 154-187. <https://doi.org/10.15446/male.n12.73267>
- Leuridan, J. (2019). *El sentido de las dimensiones éticas de la vida*. Universidad de San Martín de Porres.

- Liang, M. (2017). Why Japan needs English, *Cogent Social Sciences*. *Morita, Cogent Social Sciences*, 3(1), 1-11. <https://doi.org/10.1080/23311886.2017.1399783>
- Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.
- Lyotard, J.-F. (1984). *The postmodern condition: The Postmodern Condition: A report on Knowledge* (G. Bennington & B. Massumi, Transl., 1<sup>ST</sup> ed.). University Of Minnesota Press.
- Macdonald, K., & Tipton, T. (1993). Using documents. In Gilbert, N. (Ed.) *Researching Social Life*, 187-200. Sage Publications.
- Méndez, P., Garzón, E., & Noriega-Borja, R. (2019). English Teachers' Subjectivities: Contesting and Resisting Must-Be Discourses. *English Language Teaching*, 12 (3), 65-76. <https://doi.org/10.5539/elt.v12n3p65>
- Méndez, P., Garzón, E., Noriega-Borja, R., Rodríguez, F., & Osorio, G. (2020). 'English Teacher', *subjetividad y enseñanza del inglés en Bogotá*. Editorial Universidad Distrital.
- Nunan, D. (2015). *Standard English, English standards: Whose standards are they in English Language education?* In L. T. Wong y A. Dubey-Jhaveri. *English Language Education In A Global World*. <https://doi.org/10.13140/RG.2.1.4479.1129>
- Nussbaum, M.C. (2011). *Creating Capabilities: The Human Development Approach*. The Belknap Press of Harvard University Press.
- Pennycook, A. (1998). *English and the discourses of colonialism*. Routledge.
- Phillipson, R. (2012). *Imperialism and colonialism*. In B. Spolsky (Ed.), *The Cambridge Handbook of Language Policy* (pp. 203–235). Cambridge University Press.
- Qi, G.Y. (2016). The importance of English in primary school education in China: perceptions of students. *Multiling*, 6 (1). <https://doi.org/10.1186/s13616-016-0026-0>
- Romaine, S. (2017). *Language Endangerment and Language Death. The Future of Language Diversity*. The Routledge Handbook of Ecolinguistics.
- Román, D., Pastor, A., & Basaraba, D. (2019). Internal linguistic discrimination: A survey of bilingual teachers' language attitudes toward their heritage students' Spanish. *Bilingual Research Journal*, 42(1), 6-30. <https://doi.org/10.1080/15235882.2018.1563006>
- Seidlhofer, B. (2005). Key concepts in ELT: English as a Lingua Franca. *ELT Journal*, 59(4), 339-341. <https://doi.org/10.1093/elt/cci064>
- Soto Urrea, W. H. (2009). *Instancias y estancias de la pedagogía. La pedagogía en movimiento*. [Instances and stays of pedagogy. Pedagogy in motion]. Universidad de San Buenaventura.
- Soto Urrea, W. H. (2013). *Cibernética y pedagogía: una mirada desde la física y la matemática hacia la pedagogía del algoritmo*. [Cybernetics and pedagogy: a look from physics and mathematics towards the pedagogy of algorithm]. Universidad de San Buenaventura.
- Steger, M. (2009). *Globalization. A very short introduction* (2<sup>a</sup> ed.). Oxford University Press.
- The Office of the United Nations High Commissioner for Human Rights. (2019). *Many indigenous languages are in danger of extinction*. <https://www.ohchr.org/EN/NewsEvents/Pages/Indigenousslanguages.aspx>

- UNESCO. (2003). *Language Vitality and Endangerment. Presented at the International Expert Meeting on UNESCO Programme Safeguarding of Endangered Languages*. Paris: UNESCO Ad Hoc Expert Group on Endangered Languages. <https://unesdoc.unesco.org/ark:/48223/pf0000183699>
- Velázquez, I. (2018). *Household perspectives on minority language maintenance and loss: language in the small spaces*. Multilingual Matters.
- Vygotsky, L. S. (1978). *Mind in society*. Harvard University Press.
- Walsh, C. (2010). Interculturalidad crítica y educación intercultural. [Critical interculturality and intercultural education]. In J. Viaña, L. Tapia., & C. Walsh. *Construyendo interculturalidad crítica* (pp. 75-96). Instituto Internacional de Integración del Convenio Andrés Bello III-CAB.
- Xu, Z. (2018). Exploring English as an International Language- Curriculum, Materials and Pedagogical Strategies. *RELC Journal*, 49(1), 102–118. <https://doi.org/10.1177/0033688217753848>
- Zwisler, J. J. (2018). Language Policy and the Construction of National Identity in Colombia. *Encuentros*, 16(1), 133-146. <https://doi.org/10.15665/.v16i01.700>

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

## **A NUTRITION VIEW OF COVID 19 IN THE PANDEMIC**

**Prof. Dr. Ana Lúcia Alves Caram (Corresponding Author)**

Nutrition Course, Unimogi, Mogi Guaçu, São Paulo, Brazil

e-mail: [anacaram@uol.com.br](mailto:anacaram@uol.com.br)

**Gracinalda de Oliveira Silveira**

Nutrition Course, Unimogi, Mogi Guaçu, São Paulo, Brazil

**Edna Cristina Mariano de Lima**

Nutrition Course, Unimogi, Mogi Guaçu, São Paulo, Brazil

**Prof. Esp. Anna Christina Aires Braga Carneiro**

Nutrition Course, Anhanguera University, Campinas, São Paulo, Brazil

**Prof. Ms. Josiane Ferreira de Mello**

Nutrition Course, Unimogi, Mogi Guaçu, São Paulo, Brazil

**Prof. Dr. Eliana Setsuko Kamimura**

Faculty of Animal Science and Food Engineering, University of São Paulo, Pirassununga, São Paulo, Brazil

**Prof. Dr. Mônica Roberta Mazalli**

Faculty of Animal Science and Food Engineering, University of São Paulo, Pirassununga, São Paulo, Brazil

**Prof. Ms. Thelma Fernandes Feltrin Rodrigues**

Nutrition Course, Universidade Nove de Julho, São Paulo, São Paulo, Brazil

**Prof. Dr. Ana Raquel Medeiros Beck**

Multiprofessional Residency Program in Child and Adolescent Health, PUCCAMP, Campinas, São Paulo, Brazil

**Prof. Dr. Rafael Resende Maldonado**

Technical College of Campinas, University of Campinas, Campinas, São Paulo, Brazil

### **ABSTRACT**

*COVID-19 is a disease caused by a coronavirus, called SARS-CoV-2. This virus has become a major public health concern worldwide, causing a collective outbreak, leading to the pandemic in 2020. People become*

*infected with other common coronaviruses throughout their lives, but currently the concern is the COVID-19 type due to its severity in some cases. The immune system protects the body against external aggressions and preserves the body's homeostasis, and nutrients are involved in the development and preservation of this system. Considering the degree of complications that can occur in an individual with COVID-19, regardless of their age group, and in some cases even lethal, there was an interest in researching studies about this disease, and which nutrients are mentioned in the literature regarding immunity in this disease. The aims of this research were to describe concepts about the disease COVID-19 and to identify nutrients involved in the immunity and treatment of this disease, through a literature review in the period from December 2019 to October 2020. There is no doubt that it is essential to maintain an adequate nutritional status, through a balanced diet that can contribute to a better coping with the infectious state. Supplementation of vitamins, minerals, probiotics and prebiotics can provide the immune system, several of them were cited as an adjunct to the treatment of COVID-19, including their doses, but there was a lack of agreement regarding the dose of nutrients. Obviously maintaining social distance, wearing masks and proper hygiene are essential to reduce the risk of contamination, while not having access to vaccination.*

**Keywords:** COVID-19, nutrition, immunity, SARS-CoV-2, nutrients.

## 1. INTRODUCTION

The coronavirus, COVID-19, has become the main public health concern worldwide, causing a collective outbreak, leading to the pandemic. It was first diagnosed in December 2019 in Wuhan, China, from where it spread rapidly to many other countries [1, 2].

According to WHO [2] the number of cases on November 20, 2020 in the world reached 56,623,643 confirmed cases and more than 1,355,963 deaths, varying depending on the region: in the Americas region 24,035,426 confirmed cases, 690,020 deaths; Europe 16,353,141 and 365,480; Eastern Mediterranean 3,725,280 and 94,332 deaths; in Africa 1,431,795 and 32,232 respectively, finally globalized growth, and in some recurring places.

The human coronaviruses were isolated for the first time in 1937; however, it was in 1965 that the virus was described as coronavirus, due to the profile of its microscopy, looking like a crown. Most people become infected with common coronaviruses throughout their lives, which are alpha coronavirus 229E and NL63 and beta coronavirus OC43, HKU1 [3]. However, currently the concern is the type of coronavirus COVID-19 due to its severity in some cases. Preventive solutions to control the level of spread of the virus are necessary, such as social withdrawal and hygiene measures [4].

COVID-19 is a disease caused by the coronavirus, called SARS-CoV-2 (SARS = “Severe Acute Respiratory Syndrome”). It is a virus family that can cause respiratory infections and other clinical complications, and in its severe form, it can evolve to intense inflammation, triggered by an exaggerated immune response – a “storm” – of cytokines that can lead to damage to various organs, leading to death. Antioxidant compounds can be considered in an attempt to reduce this storm associated with the virus [3, 5].



Patients may present asymptomatic infections to severe respiratory complications, ranging from a simple cold to severe pneumonia. They may present other symptoms such as: cough, fever, runny nose, sore throat, anosmia (loss of smell), ageusia (taste change), asthenia (tiredness), hyporexia (decreased appetite), dyspnoea (shortness of breath), gastrointestinal disorders (nausea/vomiting/diarrhea). Most of the contaminated 80% are asymptomatic or oligosymptomatic (little symptoms) 20% may need hospitals due to complications with respiratory problems and 5% may have ventilatory support needs [3].

The maintenance of the immune system is necessary to produce responses to infectious agents, for regeneration and to prevent the worsening of diseases. Scientific studies prove that the deficit of nutrients in food and malnutrition are directly linked to the immune system: when you have good nutrition the immune system is more resistant. It is necessary to have a healthy diet, an active life regardless of age to sleep well. For good immunity, these are the main defenses against infectious agents [3, 6]

The elderly and the chronically ill are the groups with the highest risk of infection, being exposed to the highest risk of mortality. An individual aged 60 years or more has a greater chance of decreasing the functions of the immune system, in addition to presenting gradual loss of muscle mass and skeletal function (sarcopenia), triggering an increased severity of infectious diseases that can complicate with COVID 19. They are more prone to a higher mortality rate associated with viral infection, and they can even reach more severe stages of COVID 19 [7, 8].

According to Ros [9], another group of patients considered to be at greater risk is the obese and patients with comorbidities, as they may have greater chances of complications with COVID-19, such as diabetes, cardiovascular diseases and systemic arterial hypertension. These complications are frequently caused by inadequate eating habits, further compromising the treatment of infected patients.

The entire population was affected by social distance, but the elderly are the population most affected by the measures of social isolation and reduction of the contagion of the virus, implemented worldwide. On the other hand, social isolation can expose them to a greater nutritional risk due to factors such as socioeconomic insecurity, which can affect the acquisition of food, the need for support in daily tasks and meals. Elderly people often depend on food donations, which may have decreased due to the economic crisis caused by the pandemic in addition to the aging process itself, changes in nutritional needs and eating habits [10].

COVID-19 reactivated discussions on the importance of food, food security, nutrition and hunger, now more emphasized by the emergence of the pandemic, involving the extent and magnitude of nutritional and social problems. In Brazil, involving the three spheres of government (federal, municipal and state) to ensure access to adequate and healthy food, highlighting that this is a right of all, with a view to reducing nutritional deficiencies and the negative impacts of the disease on the condition of food, health, nutrition and immunity, especially in the most vulnerable [11]. The pandemic affected several countries in the world and in some situations led to the financial crisis, that is, no income, no food or less food, affecting the entire food system and revealing its fragility [2].

Through these described aspects, the degree of complication that an individual with the COVID-19 virus can reach, regardless of their age group, being in some cases even lethal, the interest in researching concepts about this disease arose, and which nutrients are mentioned in the literature regarding immunity.

Thus, the aims of this research were to describe concepts about COVID-19 disease and to identify nutrients involved in immunity and treatment of this disease.

## **2. METHODS**

This research was developed through a bibliographic survey of scientific articles in the databases Scielo, Google Scholar, MedLine and social media when articles with interesting titles were published in academically respected magazines. The websites of the Ministry of Health (MS) and the World Health Organization (WHO), Federal Council of Nutritionists (CFN), were also used from December 2019 to October 2020. The keywords used for the research were: COVID- 19, nutrition and immunity. Articles that did not address the objectives of this study were excluded.

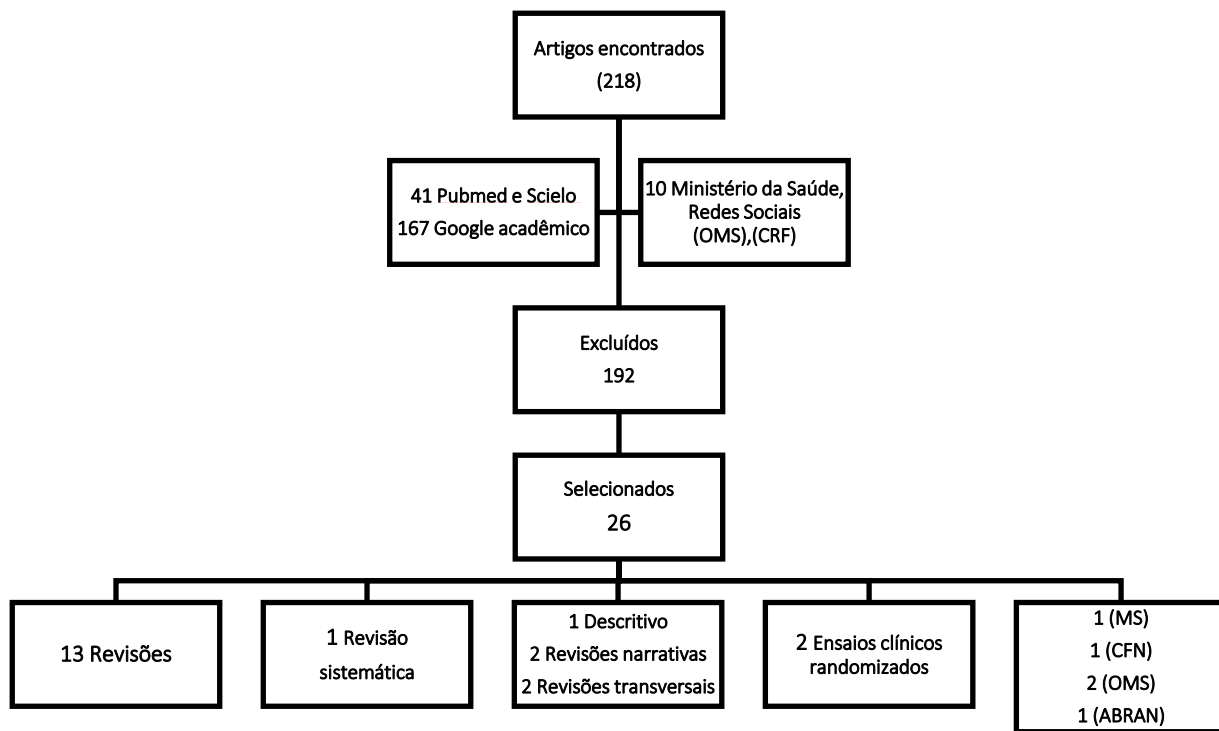
## **3. RESULTS AND DISCUSSIONS**

### **3.1.General Aspects**

One took steps to select the articles according to the flowchart shown in Figure 1. One found 218 articles, and 26 were used for the development of this research due to their titles and objectives of this research. Their languages were: Portuguese (18), English (7), Spanish (1).

The nutritional status directly interferes with the immune response, so in individuals with nutritional deficiencies, there is a higher incidence of development of various diseases and the recovery from the disease is slower. In this context, the use of food supplements as a complement to feeding can bring benefits in relation the immune response, reducing the power of infection of certain pathogens, or even accelerating the individual's recovery process [6].

Zhang and Liu [4] suggest the importance of checking the nutritional conditions of each infected patient and, based on a review of the literature regarding the forms of treatment, they mentioned some nutrients that could be considered as therapy: vitamins A, B2, B3, B6, C, E, and the minerals Selenium and Zinc. A balanced diet is capable of providing nutrients such as vitamins A, D, C, B complex, Iron, Zinc and Selenium, among others, which can act positively on the immune system. However, the use of supplementation can improve immunity in the treatment of COVID-19 [12].



**Figure 1-**Fluxogram of the selected articles

Food supplements with vitamins, minerals, bioactive substances and probiotics, foods with claims of functional property, are defined in Brazil by the ANVISA (National Health Surveillance Agency), through resolution No. 243/2018. According to this resolution, food supplements can be defined as a "product for oral ingestion, presented in pharmaceutical forms, intended to supplement the diet of healthy individuals with nutrients, bioactive substances, enzymes or probiotics, isolated or combined". Food supplements cannot contain on their labels claims for medicinal or therapeutic purposes, whether preventive, palliative or curative; doses are indicated by the manufacturers for the different populations and also published in Anvisa, vitamins A, B12, B6, B9, C, D, and the minerals copper, iron, selenium and zinc are allowed in the labels "auxiliary in the functioning of the immune system". [6, 13].

Diagnosing the risk of malnutrition should be an initial step in the general assessment of all patients in the population at risk, such as the elderly, individuals with chronic diseases, with obesity, acute diseases and children. Thus, the use of nutritional screening methods, such as MUST \* and NRS2002 \*\* can contribute to diagnosis and nutritional treatment [7].

\*Critério Must : See at: <https://www.bapen.org.uk/screening-and-must/must-calculator>.

\*\*NRS-2002 : See at: <https://www.mdcalc.com/nutrition-risk-screening-2002-nrs-2002>.

Malnutrition must be diagnosed not only by low body mass index, but also by the inability to preserve healthy body composition and skeletal muscle mass. Therefore, it is important to offer an adequate nutritional supply to patients at different times of the disease. Caloric needs can be identified by means of indirect calorimetry or as alternative prediction equations or weight based formulas, these are presented below in Chart 1 [7].

The protein must be individually adjusted in relation to the nutritional status and level of physical activity, severity of the disease and tolerance of the patient. For the elderly, 1 g of protein per kg body weight per day. Equal or above 1 g for hospitalized polymorphs to prevent weight loss, reduce the risk of complications, hospital readmission and improve the functional result. At a critical moment in the evolution of the disease, the protein intake must be increased to 1.3 kg. While the fats and carbohydrates will have to be adapted to the 30:70 total calories in individuals without respiratory deficiency and 50:50 ventilated patients. Obviously assessing your best route of administration of the diet whether oral, enteral or parenteral [7].

**Chart 1: Formulas for calculating caloric needs based on weight based formula per day**

**27 kcal/kg** body weight/day for polymorbid patients aged > 65 years

**30 kcal/kg** body weight/day for severely underweight polymorphic patients

In elderly people, this value should be adjusted individually in relation to nutritional status, physical activity level, disease status and tolerance.

The target of **30 kcal/kg** of body weight in severely underweight patients should be gradually evolved to avoid the refeeding syndrome.

In a critical patient with enteral feeding, it is recommended to start the more gradual caloric intake **20 kcal/kg** of body weight, increasing from 50 to 70% of energy on the 2<sup>nd</sup> day and reaching 80 to 100% on the 4<sup>th</sup> day.

If intolerance to enteral nutrition is present, parenteral nutrition should be considered

**Source:** Adapted from ESPEN, 2020 [7].

In another study, one showed that patients with COVID-19 should have an intake of 1.5 g of protein per kg, 25-30 kcal per kg of weight. Vitamins A, B6, B12, C, E, folate, trace elements such as zinc, iron, selenium, magnesium and copper help the immune system and can promote the recovery of inflammation. On the other hand, the lack of micronutrients affects immune function negatively and may decrease resistance to infections [5].

Malnutrition is associated with affected immunity. Among the micronutrients that play important roles in the immune response, one can highlight vitamins A, D, C, E and complex B. Several studies have shown that vitamin A can lead to reduced complications and mortality from various infectious diseases and vitamin C can reduce the rate of pneumonia. On the other hand, several studies have reported that deficiency of vitamins B, D and E can make the body more vulnerable to the virus and impair immune system responses. Effective medications are needed for treatment, to improve the regulation of the immune system and the condition of the patient, due to the wide severity and mortality rate. Studies have pointed out the effectiveness of multivitamin supplementation, including vitamins A, B, C, D, E in improving and mortality rates in patients with COVID-19 in intensive care units in Iran [14].

There is no consensus or recommendation for the specific use of nutrients in the literature that points to the reduction of viral load in infections, increased immune response or prevention of acute or chronic

viral conditions. However, one can identify some aspects in the literature that may contribute to this pandemic moment of COVID 19, in Tables 1 and 2, in addition to the contextualized ones.

**Table 1 – Vitamins and benefits against COVID 19**

<b>Nutrient</b>	<b>Benefit</b>	<b>Recommendations</b>
Vitamin A	Anti-infectious, helps in the defense of the organism against infections [15, 16]	Adults: 700 mcg/day for women; 900 mcg/day for men [16].
Complex B vitamins	It has an anti-inflammatory effect acting on the immune response; Indicated as a basic treatment option for COVID-19 [4, 14]	In patients ICU from 20 to 60 years: B2 -3.6 mg/day; B5 – 15 mg/day and B6- 4.0 mg/day [14].
Vitamin C	Antioxidant and positive impact on the immune system; Protects the body against infections, prevents respiratory infections, relieves flu-like symptoms. Improved flu symptoms [5, 16 – 19].	1 g/day respiratory infections does not prevent, but is able to reduce or alleviate them; 1-4 g /day for ICU patients [5].  2g/day [16].
Vitamin D	Modulation of the immune system decreases viral replication, increasing innate immunity [14, 16].	From 1 to 12 years old: 3,000 to 6,000 IU/day, taken orally; 12 years or more: 6,000 IU/day, orally [20]. General dose to risk group: 2,000 – 4,000 orally/day; If vitamin D $\geq$ 20 to 30 ng/ mL in blood: 25,000 IU a week. If vitamin D < 20 ng/mL in blood: 50,000 IU a week [16]. 600,000 IU once (20 to 60 years old) for ICU patients [14].
Vitamin E	Immunological effects, reduces oxidative stress that triggers inflammation [6, 14].	In patients ICU from 20 to 60 years: 2 doses 300 IU /day [14].

In addition to the aforementioned nutrients, it is also important to highlight the polyunsaturated fatty acids (PUFAs) as omega 3, which can be considered functional nutrients, due to their effects. However, so

far there is little evidence of its use as a prophylactic or therapeutic agent against COVID 19 [5, 6]. It is important to emphasize that social and solidarity initiatives, also considering the most vulnerable, with a sustainable view, food and nutrition education through educational programs in the media (television, virtual or radio) can guide and encourage the adoption and maintenance of healthy eating habits for all, with health precautionary measures, in addition to monitoring nutritional conditions, including via online technologies. The nutritionist can contribute by working in multidisciplinary teams in the treatment of COVID-19 and assisting in educational campaigns in its prevention [2, 11, 21].

### **3.2.Vitamin A**

Vitamin A helps in defense against infections, and acts significantly in immunity. There are reports in the literature of the benefit in reducing morbidity and mortality in different infectious diseases, such as measles, diarrheal diseases, measles-related pneumonia, infection by the human immunodeficiency virus (HIV) and malaria. It can be a promising option for the treatment of coronavirus and the prevention of pulmonary infection [4].

As it is not synthesized by the body, it is ideal to obtain through food. The main sources of animal origin are milk, yogurt, cheese, liver meat, fish oils, milk and vegetable origin can be found in carrots, pumpkin, kale, spinach, sweet potatoes, papaya, mango and oil red palm [15].

### **3.3.Complex B vitamins**

The B-complex vitamins are water-soluble vitamins and function as part of coenzymes, with specific functions, such as the following examples: vitamin B2 (riboflavin) which plays a role in the energy metabolism of all cells; vitamin B3 (niacin) was able to increase the death of *Staphylococcus aureus*, and it was effective in preventive and therapeutic contexts, also significantly inhibited the infiltration of neutrophils into the lungs, with a strong anti-inflammatory effect during ventilation and induced lung injury; vitamin B6 is involved in protein metabolism and participates in more than 100 reactions in the body's tissues, also acting on immune function. Complex B deficiency can weaken an individual's immune response. Thus, they should be supplemented in patients infected by the virus to improve their immune system, and can be chosen as a basic option for the adjuvant treatment of COVID -19 [4].

### **3.4.Vitamin C**

The severity of COVID-19 infection in pulmonary deterioration is already known. However, the reason for this rapid deterioration is not yet complete, it is described that it has similarities with the macrophage activation syndrome which is the organism's first line of defense, secondary forms of pro-inflammatory hypersecretion that damage the lungs, hence the intravenous administration of vitamin C may be effective due to its powerful anti-inflammatory activity [18].

In addition, vitamin C, is an antioxidant, has a role in the metabolism of the human body including energy transformations, iron absorption, antimicrobial properties; it reduces the risk of infections, with immunomodulatory functions. Particularly at high concentrations, vitamin C plays a crucial role in immunomodulation, inhibiting the activation of the pro inflammatory transcription factor, genetic regulation and inhibitors of apoptosis (cell death). Vitamin C in high doses can inhibit oxidative stress. An



important part of the innate immune response to viral respiratory infection can progress to lung injury. Oxidative stress can also play a role in the COVID-19 mechanism. It has been reported that Vitamin C can repair oxidative damage in the human pulmonary bronchial epithelium by modulating the generation of reactive oxygen species and inflammatory expression. This vitamin can prevent lung damage, regulating the clearance of alveolar fluid by increasing the function of the pulmonary epithelial barrier, the protein channels that regulate the clearance of alveolar fluid; it can help to decrease symptoms of acute respiratory distress syndrome and improve respiratory function [22].

### **3.5.Vitamin D**

Vitamin D has a protective role in preventing and reducing the risk of acute respiratory tract infections, including viral infections. Vitamin D can be a potential adjunct to the protection and treatment of patients with respiratory viral infections that normally have low levels of vitamin D. During the pandemic of COVID-19, vitamin D supplementation can be an important step in preventing infection and spread. However, the hypothesis that vitamin D supplementation may reduce the risk of SARS-CoV-2 and the incidence of death from COVID-19 is still under investigation, so clinical trials to determine the appropriate doses and prove this hypothesis are fundamental [23].

Vitamin D, through innate immunity, induces catechins and decreases viral replication. It can be obtained in the diet, supplementation, or by solar means. In the skin, it is activated with the incidence of UVB rays [5]. In the presence of a deficit of 25-hydroxyvitaminD (25 [oh], cholecalciferol should be promptly supplied according dot the results os serum levels with 50.000 IU a week if above 20 ng/mL or 25.000 UI a week  $\geq 20$  to 30 ng/ mL and follow the evolution [16].

Martins and Oliveira [19] present in their research several studies by different authors with varying doses of vitamin D. A study in progress in COVID-19 with a single dose of 200,000 IU of vitamin D, another study in 2012 with the same dose in respiratory tract diseases, this did not reduce the incidence or severity of the disease. Another one from 2017 with 100,000 IU of vitamin D in the elderly in preventing acute respiratory infections decreased the incidence of respiratory diseases. Finally the study of Beigmohammadi et al. [14] during of 7 days in patients with covid 19 in ICU used 600.000 IU once.

In a cohort study of 489 subjects who obtained the amount of vitamin D assessed in the year prior to the COVID-19 test, the risk of a positive test for this disease was 1.77 times higher in individuals with probable vitamin D deficiency compared to patients with likely sufficient vitamin D status, this difference, which was statistically significant, appears to be able to support the role of the lower vitamin D level in the risk for COVID-19 [24].

### **3.6.Vitamin E**

It is a group of fat-soluble antioxidants. Vitamin E deficiency impairs immune functions; it can have immune effects by reducing oxidative stress, it is associated with the protection of polyunsaturated fatty acids (PUFAS), it regulates the production of reactive oxygen and nitrogen species, protects cells against oxidative damage due to the high concentration of metabolic activity and the PUFA content. So far, there is no evidence about its use as a prophylactic and therapeutic agent against COVID 19 [5].

With the protective function for the lipid portion of the plasma membrane, reducing oxidative damage, vitamin E is able to regulate the production of reactive oxygen generated from oxidative stress and also reactive nitrogen. Considering immunity, it can increase the production of lymphocytes, decrease the production of interleukin 6, increase the activity of interleukin 2, decrease inflammatory respiratory diseases and prevent infectious diseases [15]. According to Zhang and Liu [4] a study carried out on calves identified that the decrease in vitamin D and E caused the infection with bovine coronavirus.

### **3.7.Minerals**

Copper is associated with the defense cell functions, both in innate immunity and in adaptive immunity, its deficiency is associated with an increase in infections. One found that the SARs-CoV-2 virus is very sensitive to the surface of copper, as exposure of human coronavirus to copper resulted in destruction of the viral genome and affected the morphology of the virus. Copper deficiency is rare and its imbalance is usually related to individuals with severe diseases receiving exclusively parenteral nutrition, which does not include this nutrient [5].

According to Zhang and Liu [4], iron deficiency is associated with a risk factor for diseases resulting from acute respiratory tract infections, while a high iron load can cause oxidative stress to spread harmful viral mutations.

A study carried out at the University of Surrey, in England, published in the American Journal of Clinical Nutrition, was able to identify a link between the recovery rate of SARs –CoV-2 and the consumption of selenium. Selenium is of great importance for human health and can be obtained through a diet that contains fish, meat and cereals, proving to be important in combating various diseases and their progressions. In China, differences in geographic soils affected selenium levels and amounts in the diet to low or high levels. In this study, regional data were examined, where it was found that areas with a high selenium value had greater possibilities for improvement in their COVID-19 condition. In the city of Enshi, which belongs to Hubei province, a higher selenium intake was recorded, and the number of patients' improvement was almost three times the average for all other cities. On the other hand, in Heilongjiang Province, where selenium intake is one of the lowest in the world, the COVID-19 mortality rate was almost five times higher than the average for all other provinces, concluding that the higher the dosage of selenium in the population, the greater the number of individuals with COVID-19 who recovered. The suggested dose was 55 micrograms every day [4].

Zinc is an essential trace element for countless essential human mechanisms. It has amounts ranging from 1.5 to 2.5 g in the body of an adult. Most of this mineral is found in the fat-free mass, mainly inside the cells, in the skeletal musculature and in the bone mass, they have the largest amount of the mineral. The main sources are oysters, red meats, viscera (liver and kidneys), seafood, oilseeds, whole grains, legumes and milk. Fruits and vegetables lack significant amounts of this nutrient. Food from animal sources has the largest source, while vegetables the smallest [19].

Zinc is involved in the regulation of carbohydrate and lipid metabolism. It can modulate antiviral and antibacterial immunity, and regulates the inflammatory response. In vitro experiments have shown that zinc has antiviral activity in the RNA polymerase in SARs-CoV-2, so it is considered that zinc compounds can be used in the therapy of the treatment of COVID 19 [5].

The doses of Zinc also vary, a study in pediatrics has shown that 10 mg and 20 mg in children under 1 year of age improved the respiratory rate and saturation of children with pneumonia and the use of 10 mg zinc associated with vitamin C 1,000 mg per day improved discomfort in colds [19].

**Table 2 – Mineral and benefits against COVID**

Nutrient	Benefits	Recommendations
Copper	Effective in eliminating virus infections such as bronchitis or polyvirus [5]	Not presented
Iron	Deficiency can be a risk factor for acute respiratory tract infections [4]	Not presented
	Immunomodulator, acts directly on the immune system.	
Selenium	Deficiency of this nutrient can increase the chance of mortality in COVID-19 [4, 16, 25].	Adults: 55 mcg/day [16, 25].
Zinc	Determinant for maintenance of immune function, zinc antiviral activity has been reported by inhibiting viral replication in cell culture, inhibiting the RNA activity of coronavirus [9, 16].	From 20 to 60 years old: 8 mg/day women; 11 mg/day men; 20- 40 mg/day if the patient present diarrhea, taken orally [16].

### 3.8.Probiotics and Prebiotics

The gastrointestinal tract houses a huge population of microorganisms, called human gut microbiota, which interact with each other on the host's epithelium and immune system. Changes in quantities relative to the population and intestinal microbial diversity can disrupt the beneficial interactions between the microbiota and the host (dysbiosis), with a direct effect on human health. Some patients with COVID-19 infection have gastrointestinal repercussions (abdominal pain, diarrhea) due to direct viral contamination in the intestinal mucosa or consequent to changes in drug treatment. The imbalance of the microbiota can lead to the translocation of gut bacteria, which favors secondary infections and worsens the patient's general condition. Although there is no consensus, recent recommendations indicate that the use of probiotics in COVID-19 infection can contribute to treatment. Researchers are studying the use of probiotics or symbiotic bacteria to reduce pneumonia associated with mechanical ventilation and serious infections [16].

COVID-19 interacts with the intestinal microbiota, and in 5 to 10% of cases, diarrhea and gastrointestinal symptoms were present. There is a cross-interaction between the intestine and lung, called the intestine-lung axis, where endotoxins and microbial metabolites can affect the lung and inflammation of the lung parenchyma and can alter the gut microbiota. Probiotics have shown good results in improving inflammatory conditions and regulating innate immunity. Prebiotics such as fructooligosaccharides (FOS) and galactosaccharides (GOS) increase butyrate concentrations thereby reducing inflammation, while dietary fiber increases short-chain fatty acids (SCFAs) protecting against inflammation in the lungs. The

consumption of whey and pea protein increased the gut bacteria bifidobacterium and lactobacillus. Yogurt probiotics appear to significantly reduce enteropathogens such as *E. coli* and *Helicobacter pylori* [5].

The rebalancing of the gut microbiota can reduce enteritis and pneumonia. Thus, the hypothesis about the use of probiotics, such as *Lactobacillus rhamnosus* and *Bifidobacterium*, may contribute to the improvement of innate and adaptive immunity. The inclusion of prebiotics and probiotics can improve and accelerate the recovery of patients infected with the SARs-CoV-2 virus [5].

#### 4. FINAL CONSIDERATIONS

A healthy diet favors the immune system, contributing to good homeostatic functioning and the actions of nutrients, enhancing the body's prevention of possible viral infections. On the other hand, nutritional deficiency favors the worst prognosis in viral infections. It is noticed that there was a lack of agreement regarding the doses of nutrients in COVID-19, on the other hand, there is no doubt that it is essential to maintain an adequate nutritional status, through a balanced diet that can contribute to a better coping with the infectious state. Supplementation of vitamins, minerals, probiotics and prebiotics can boost the immune system, several of which have been cited as an adjunct to the treatment of COVID-19, including its doses. Obviously maintaining social distance, wearing masks and proper hygiene are fundamental to reduce the risks of contamination, while there is no access to vaccination and its proven effectiveness in the entire population.

#### 5. ACKNOWLEDGMENT

We would like to thank the Professor Dr. Julia Laura Delbue Bernardi for her collaboration and motivation to publish this article.

#### 6. REFERENCES

1. LAI, C.C.; SHIH, T.P.; KO, W.C.; TANG, H.J.; HSUEH, P.R. Severe acute respiratory syndrome coronavirus 2 (SARS- CoV- 2) and corona virus disease-2019 (COVID-19): the epidemic and the challenges (2020). **International Journal of Antimicrobial Agents**, 105924.
2. WHO (2020). Available at: <https://www.who.int/news/item/13-10-2020-impact-of-covid-on-people%C2%B4s-livelihoods-their-health-and-our-food-systems> Accessed in Oct 16<sup>th</sup>, 2020.
3. BRASIL. Health Minister. About the Disease (2020). Available: <https://coronavirus.saude.gov.br/sobre-a-doenca#o-que-e-COVID> Accessed in Apr 20<sup>th</sup>, 2020 and Oct 04<sup>th</sup>, 2020.
4. ZHANG, L.; LIU, Y. (2020). Potential interventions for novel coronavirus in China: a systematic review. **Journal of Medical Virology**, 92: 479-490.
5. DIAS, M.J.L.E.; CHINI, M.C.; CARDOSO, T.F.; ORRICO, S.R.P.; PEREIRA, B.L.B. (2020). COVID 19 e Nutrição. **Ulakes Journal of Medicine**, 1: 106-117.
6. BOMFIM, J.H.G.G.; GONÇALVES, J.S. (2020). Suplementos alimentares, imunidade e COVID-19: qual a evidência? **VITTALLE-Revista de Ciência da Saúde**, 32: 10-21.

7. BARAZZONI, R.; BISCHOFF, S.C.; BREDI, J.; WICKRAMASINGHE, K.; KRZNARIC, Z.; NITZAN, D.; PIRLICH, M.; SINGER, P. (2020). ESPEN expert statements and practical guidance for nutritional management of individuals with SARS-CoV-2 infection. **Clinical Nutrition**, 38: 1631-1638.
8. FLORES, T.G.; LAMBERT, M.A. (2020). Por que idosos são mais propensos a eventos adversos com a infecção por COVID-19. **Comentários, RAGG especial Covid-19 e Coronavírus**. Available at: <https://raggfunati.com.br/docs/COVID/Flores%20e%20Lampert.pdf>. Accessed in: May 7<sup>th</sup>, 2020.
9. ROS, D.C.; BRASIOLI, M.; GUILHERME, R.C. (2020). Guia para uma alimentação saudável em tempos de COVID-19. Available at: <https://www.asbran.org.br/storage/downloads/files/2020/03/guia-alimentar-covid-19.pdf> Accessed in: Apr 20<sup>th</sup>, 2020.
10. CEOLIN, G.; MOREIRA, J.D.; MENDES, B.C.; SCHROEDER, J.; DI PIETRO, P.F.; RIEGER, D.K. (2020). **Revista de Nutrição**, 33:e200174.
11. RIBEIRO-SILVA, R.D.C.; PEREIRA, M.; CAMPELLO, T.; ARAGÃO, E.; GUIMARÃES, J.M.D.M.; FERREIRA, A.J.; BARRETO, M.L.; SANTOS, S.M.C.D. (2020). Implicações da pandemia COVID-19 para a segurança alimentar e nutricional no Brasil. **Ciências e Saúde Coletiva**, 25:3241-3430.
12. GOIS, B.P.; PEREIRA, A.D.; LOPES, K.L.S.; CORGOSINHO, F.C. (2020). Suplementação e alimentação adequada no context atual da pandemia causada pela COVID-19. **DESAFIOS-Revista Interdisciplinar da Universidade Federal do Tocantins**, 7 (Especial-3):89-96.
13. ANVISA. Agência Nacional de Vigilância Sanitária (2008). Resolução RDC nº 243 de 26 de julho de 2018. Dispõe sobre os requisitos sanitários dos suplementos alimentares. Available at: [https://www.in.gov.br/materia/-/asset\\_publisher/Kujrw0TZC2Mb/content/id/34379969/do1-2018-07-27-resolucao-da-diretoria-colegiada-rdc-n-243-de-26-de-julho-de-2018-34379917](https://www.in.gov.br/materia/-/asset_publisher/Kujrw0TZC2Mb/content/id/34379969/do1-2018-07-27-resolucao-da-diretoria-colegiada-rdc-n-243-de-26-de-julho-de-2018-34379917) Accessed in: Sept 12<sup>th</sup>, 2020.
14. BEIGMOHAMMADI, M.T.; BITARAFAN, S.; HOSEINDOKHT, A.; ABDOLLAHI, A.; AMOOZAEDH, L.; ABADI, M.M.; FOROUMANDI, M. (2020). Impact of vitamin A, B, C, D, and E supplementation on improvement and mortality rate in ICU patients with coronavirus-19: A structured summary of a study protocol for a randomized controlled trial. **Trials**, 21: 1-4.
15. LIMA, W.L.; BATISTA, M.C.C.; SILVINO, V.O.; DE MOURA, R.C.; MENDES, I.L.; DE MOURA, M.S.B.; BATISTA, N.K.C.; SILVA, K.R.; BARBOSA, A.K.D.S. (2020). Importância nutricional das vitaminas e minerais na infecção da COVID-19. **Research Society and Development**, 9: e804986103.
16. ABRAN - Associação Brasileira de Nutrologia (2020). Available at: <https://abran.org.br/2020/05/01/posicionamento-da-associacao-brasileira-de-nutrologia-abran-a-respeito-de-micronutrientes-e-probioticos-na-infeccao-por-COVID-19/> Accessed in: Sept 5<sup>th</sup>, 2020.
17. Sociedade Brasileira de Diabetes (2020). Available at: <https://www.diabetes.ogr.br/COVID-19/nutricao-imunidade-e-diabetes-em-tempos-de-coronavirus> Accessed in: Sept 14<sup>th</sup>, 2020.

18. HERNANDES, A.; PAPADAKOS, P.J.; TORRES, A.; GONZÁLEZ, D.A.; VIVES, M.; FERRANDO, C.; BAEZA, J. (2020). Dos terapias conocidas podrían ser efectivas como adyuvantes en el paciente crític infectado por COVID-19. **Revista Española de Anestesiología y Reanimación**, 67: 245-252.
19. MARTINS, M.C.C.; OLIVEIRA, A. S. D. S. S. (2020). Zinco, vitamina D e sistema Imune: Papel na infecção pelo novo Coronavírus. **Revista da faesf**, 4: 16-27.
20. ALVES, C.A.D.; CARGIN, K.R.N.; SILVA, C.C.C.; PAULA, L.C.P.; NASCIMENTO, M.L.; BARBOSA, M.E.; LIBERATORE, R.D.R.; PINTO, R.M.; ARRAIS, R.F. (2020). Vitamina D e a COVID-19. Nota de Alerta da Sociedade Brasileira de Pediatria. Available at: <https://www.sbp.com.br/imprensa/detalhe/nid/vitamina-d-e-covid-19/> Accessed in: Sept 05<sup>th</sup>, 2020.
21. CFN. CONSELHO FEDERAL DE NUTRICIONISTAS (2020). Orientações à população e para os nutricionistas sobre o novo coronavírus. Available at: <https://www.cfn.org.br/index.php/destaques/19913/> Accessed in: Oct 11<sup>th</sup>, 2020.
22. LIU, F.; ZHU, Y.; ZHANG, J.; LI, Y.; PENG, Z. (2020). Intravenous high-dose vitamin C for the treatment of severe COVID-10: study protocol for a multicenter randomised controlled trial. **BMJ Open**, 10:e039519.
23. HENRIQUES, I.; CEBOLA, M.; MENDES, L. (2020). Desnutrição, sarcopenia e COVID-19 no idoso: evidência científica da suplementação de vitamina D. **Acta Portuguesa de Nutrição**, 21:26-30.
24. MELTZER, D.O.; BEST, T.J, ZHANG, H.; VOKES, T.; ARORA V.; SOLWAY, J. (2020). Association of vitamin D status and other clinical characteristics with COVID-19 test results. **JAMA Netw Open**, 3:e2019722.
25. ZHANG, J.; TAYLOR.; ETHAN, W.; BENNETT, K.; SAAD, R.; RAYMAN, M.P. (2020). Association between regional selenium status and reported outcome of COVID-19 cases in China. **The American Journal of Clinical Nutrition**, 111: 1297-1299.



# **Bibliographic prospecting for dryeration process system evaluation in the face of the conventional grain drying**

**Jose Roberto Rasi (Corresponding author)**

Prof. Eng, Faculty of Engenharia de Produção, FACCAT College,  
Tupã SP, Brazil.

ORCID: <https://orcid.org/0000-0002-0295-599X>

Email: [jroberto.rasi@gmail.com](mailto:jroberto.rasi@gmail.com)

**Mario Mollo Neto**

Prof. Dr, Faculty of Science and Engineering, São Paulo State University – UNESP

ORCID: <https://orcid.org/0000-0002-8341-4190>

Email: [mario.mollo@unesp.br](mailto:mario.mollo@unesp.br)

**Roberto Bernardo**

Prof. Dr, Faculty of Business Administration, FADAP College

Tupã SP, Brazil.

ORCID: <https://orcid.org/0000-0002-3140-9138>

Email: [betobernardo@uol.com.br](mailto:betobernardo@uol.com.br)

## **Abstract**

*The increase in grain production causes a significant increase in the demand for suitable places to receive and store these products for a more extended time and preserve the harvested grains' properties. The drying system in the storage units has become the bottleneck for grain reception. One solution to reduce bottlenecks in the reception of grain storage units is adopting the dry-aeration operation. This work aims to present a bibliographic review of grain drying and the drying system called dryeration, based on prospecting in textual and referential databases of good factors and impact. The use of the dryeration system allows to increase the flow in the reception of the storage units, which, compared with conventional drying methods, generates an increase of over 50% in the capacity of the dryer, reduces energy consumption by up to 30%, removing up to 2% additional grain moisture and provides grains less susceptible to cracking and breaking.*

**Keywords:** Drying methods, dryer, dryeration, grain production.

## **1. Introduction and Objectives**

The modifications resulting from the modernization process with the insertion of technological innovations resulted in the improvement of agricultural productivity in Brazil, generating a significant increase in the

production of some types of grains such as soybeans and corn, making the country one of the largest agribusiness producers in the world, breaking consecutive production records, harvest by harvest [1].

The new Brazilian crop 2020/2021 results should surpass 4.2%, the record obtained in the season just finished. Grain production is estimated at 268.7 million tons, exceeding the record of 257.7 million tons from the last harvest by approximately 11 million tons. Soy production is estimated at 133.7 million tons and maintains Brazil as the world's largest producer of oilseeds, and corn production is expected to reach 105.2 million tons, considered the largest harvest of these grains, with an increase of 2.6 % over the previous harvest [2].

The increase in grain production causes a significant increase in the demand for suitable places to receive and store these products for a more extended period and preserve the harvested grains' properties [3]. Grains are usually harvested with very high moisture content for safe storage, and drying is the most common post-harvest process for long-term grain preservation [4].

The increase of production results in the drying of these grains at higher levels than that recommended for safe storage in the collecting storage units close to the grain production units (farms). Due to the large volume received, the existing drying system for grains sized to work during the whole grain receiving time is undersized for the new demand, and the solution found is drying acceleration, with an increase in the temperature of the grain. air, not controlling the temperature of the grain mass

[5]. The grain drying operation is usually the bottleneck that limits a storage unit's capacity [6].

This paper aims to present a review of the drying system called "dry aeration" (reported in the literature or other documentary sources) and discuss its main characteristics, increasing the storage units' reception flow. This system generates an increase of over 50% in the capacity of the dryer, reduces energy consumption by up to 30%, provides the removal of up to 2% of additional grain moisture, and provides grains less susceptible to cracking and breaking.

## **2. Material and Methods**

To survey the works carried out on grain drying, qualitative bibliographic research is presented [7] of academic scientific productions with a good impact factor, published in the textual and referential databases available on the Internet. Few works address the theme in Brazil, and the vast majority are published in international journals. The searches were performed by the titles of articles, dissertations, and theses, with an initial reading of abstracts and, in specific cases, a full reading of the document. After a gradual analysis, the theoretical reference framework that supports the conclusions of this paper is constructed [8].

## **3. Results and Discussion**

### **3.1 Grain drying**

Among the methods used for grain conservation, drying is the most economical from the point of view of processing and allows preserving the product in a natural environment for an extended period [9]. The purpose of reducing the water content is to prolong the useful life of products of biological origin by reducing the growth of microorganisms, insects and inhibiting enzymatic reactions [10].

Microflora and insects naturally only develop in grains at relative humidity above 65% [11], so, according

to [12], grains with a high moisture content must be dry artificially up to a moisture content, which will result in an equilibrium relative humidity within the stored grain mass of less than 65%. Corn in good condition must be dried to a moisture content below 14% for safe storage, whereas soy requires a storage moisture content of less than 12.5%. Table 1 summarizes the equilibrium moisture content in three levels of equilibrium relative humidity and a temperature of 25° C [4].

Grain	Equilibrium Relative Humidity (%)		
	60	65	70
Corn, shelled	12,4	13,2	14,0
Soybeans	10,5	11,5	12,5
Rough Rice	12,0	12,6	13,2
Wheat, hard	12,9	13,6	14,4
Wheat, soft	11,8	12,3	13,0

Table 1. The equilibrium moisture content of various grains [4]

The main objective in a drying operation is to provide the necessary heat in an ideal way to produce the best product quality with minimum total energy expenditure [13]. The removal of moisture occurs by evaporating it by transferring mass and heat between the solid and gaseous phases [14].

The evolution of these simultaneous heat and mass transfers during the drying operation causes it to be divided schematically into three periods described below. Figure 1 shows the evolution curves of the product's water content (X), its temperature (T), and its drying speed ( $dX/dt$ ), called the drying rate [15].

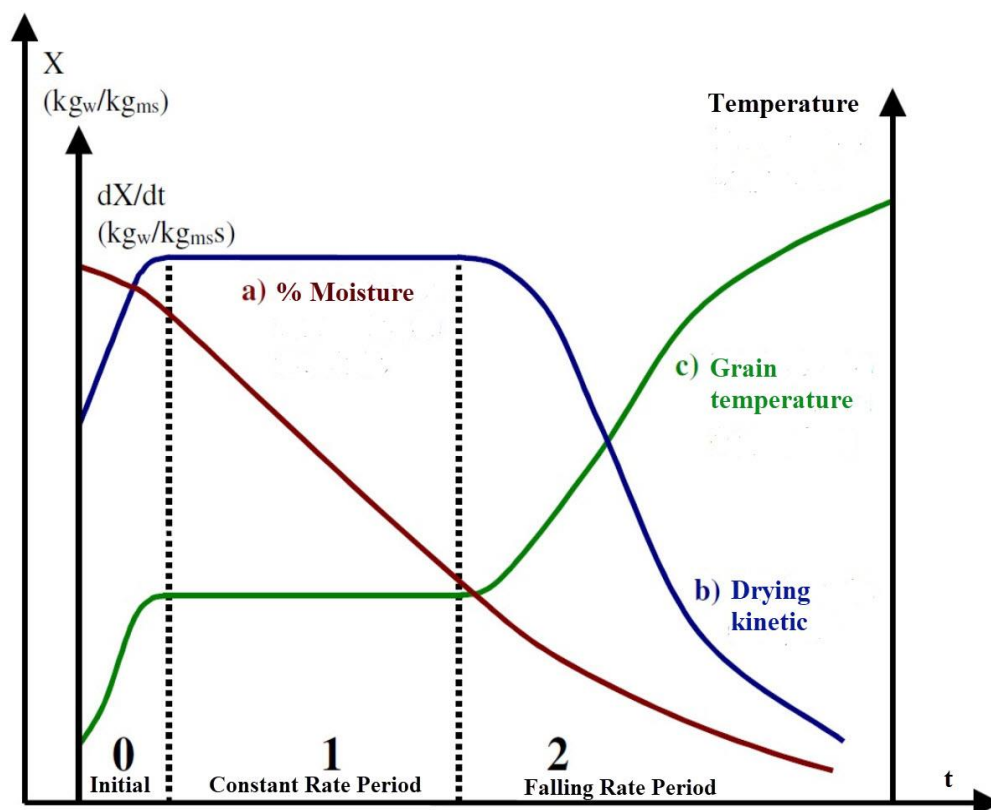


Figure 1. Typical drying curve [15]

According to the authors, in this Figure1, curve (a) represents the decrease in the water content of the product during drying; curve (b) represents the speed (rate) of drying of the product, and curve (c) represents the variation in the temperature of the product during drying. [15] then describe the three periods:

- Period 0

In the initial drying phase, where the grains are initially colder than air, the partial pressure of water vapor on the product surface is low, and the mass transfer and drying speed are also low. The heat raises the temperature of the product, with an increase in pressure and drying speed. This phenomenon continues until the heat transfer exactly compensates for the mass transfer. If the air temperature is lower than the product temperature, it will decrease until it reaches the same equilibrium state. This period's duration is too short concerning the total drying period, gradually changing to period 1.

- Period 1

It is the period where the drying rate (speed) is constant. During this period, the amount of water available within the grains is very large. The water evaporates like free water. The water vapor pressure on the surface is constant and is equal to the water vapor pressure at the product temperature. The product's temperature is also constant and is equal to the wet bulb's temperature, characteristic of the fact that the heat and mass transfer are precisely compensated.

This period lasts as long as water migration from the interior to the product surface is sufficient to supply the loss by evaporation of water on the surface.

- Period 2

It is the period of decreasing speed (rate) of drying. From the moment that water starts to be scarce on the grain surface and the drying speed decreases.

During this period, the heat exchange no longer compensates, increasing the grains' temperature and tending asymptotically to the air temperature. At the end of this period, the drying rate (speed) is zero.

Heat is the energy that flows due to the temperature difference. In our paper occurs between the drying air and the grains. Specific heat is a characteristic of each material or fluid. The higher the specific heat of a substance, the greater the energy required to vary its temperature [16].

The same author also points out that the sensitive heat is that which is added or removed from a substance, causes a temperature change without causing a phase change. That is, it only changes the temperature of the substance. Sensitive heat is related to the concept of thermal capacity, which corresponds to the amount of heat required that the total mass of a body needs to receive or lose in order for its temperature to change by one centigrade. On the other hand, latent heat is the amount of heat supplied or removed from a body. It does not change its temperature but causes a change in its aggregation state.

When a product is subjected to the drying process, water is extracted in steam by heat. This steam yields a certain amount of heat called the latent heat of vaporization [17].

[18] affirm that the air's sensitive heat is equal to the latent heat of vaporization necessary to evaporate the grains' water to the desired final moisture. In this way, sensitive heat is converting to latent heat, and this conversion can be represented by equation 1:

$$60 \cdot \left(\frac{Q}{V_e}\right) \cdot C_a \cdot (T_a - T_e) \cdot t = h_v \cdot DM \cdot (U_o - U_e) \quad \text{Eq (1)}$$

Where:

- Q: flow of drying air (m<sup>3</sup> / min);
- Ve: specific volume of the drying air (m<sup>3</sup> / kg dry air);
- Ca: specific air heat (kcal / kg °C);
- Ta: drying air temperature (°C);
- Te: equilibrium temperature (°C);
- t: drying time (h);
- hv: latent heat of vaporization (kcal / kg water);
- DM: dry material in the product (kg);
- Uo: initial humidity (decimal, d.b.);
- Ue: equilibrium humidity (decimal, d.b.).

Grains are hygroscopic products and can yield or receive water vapor from the air surrounding them [19]. According to the author, a thin layer of air forms on its surface, which constitutes a microclimate, whose state conditions are regulated by the product's temperature and moisture content. It also highlights that the air surrounding the grains also has its relative humidity related to the amount of vapor diluted in the air. The direction and intensity of the water vapor flow between the grains and the air is according to the difference of the values of relative units of the grain microclimate (URg) and the air surrounding the grain (URac) [19]

- $UR_g > UR_{ac} \rightarrow$  Grains dry;
- $UR_g < UR_{ac} \rightarrow$  Moistening of the grains occurs, and
- $UR_g = UR_{ac} \rightarrow$  Hygroscopic balance occurs, there is no vapor flow

The direction of water vapor flow will always be from the highest relative humidity to the lowest (Fig. 2).

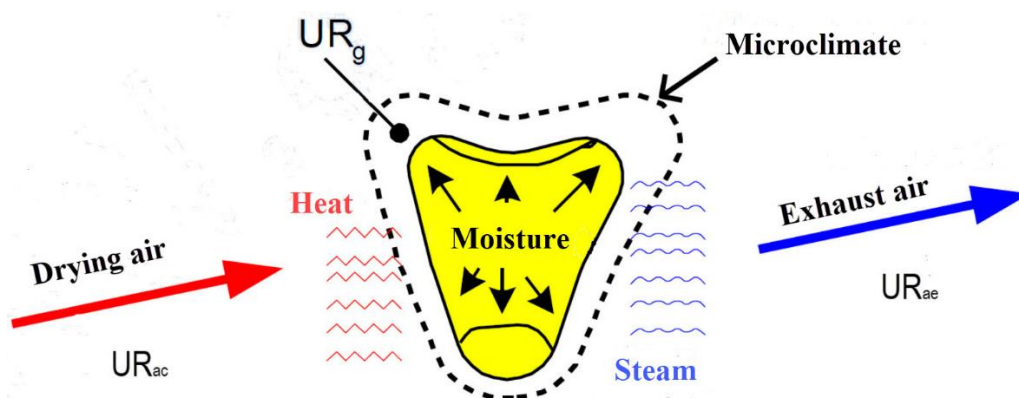


Figure 2. Demonstration of the grain drying process [19]

Heat is generally supplied during drying by heating the air, either artificially or by natural means, and the vapor pressure or concentration gradient thus created causes the movement of moisture from within the kernel (grain core) to the surface. The speed and efficiency of drying depend on the drying air temperature and humidity [20].

According to [21], energy efficiency and capacity increase as the drying air temperature increases. According to the authors, the correct way to decrease the relative humidity of the drying air is by heating, which can be naturally utilizing solar radiation or artificially using firewood or biomass furnaces, gas burners, or steam radiators. They also emphasize that increasing the temperature of the drying air leads to a decrease in the grain's quality due to cracks' appearance. Breakings and cracks in the grains are a quality indicator used by engineers and operators to determine the severity of damage done during drying.

### 3.2 Drying system

According to [22], drying methods are classified according to the use of equipment (natural or artificial), the periodicity in the heat supply (continuous or intermittent), and the movement of the seed mass (stationary or continuous). [23] classified the drying systems for agricultural products for didactic reasons, due to the lack of an official classification, according to Chart 1:

Drying system	Natural air - in the field or on the farm					
	Artificial	Natural ventilation	court or barn			
			Solar drying			
			Others			
		Forced ventilation	Natural air			
			High temperature	Flow	Fixed bed	
					Crossflow	
					Concurrent flow	
					Counterflow	
					Cascade	
					Rotary	
					Fluidized	
					hybrid solar	
			Operation	Batch		
				Continuos		
			Low temperature			
			Combination			
			Dryeration			
	Convection					

Chart 1 – Drying system [23]

According to [24], the simplest classification of grain drying methods is based on the temperature of the air used for drying and can be classified into:

- Drying in natural air
- Artificial drying at low temperatures
- Artificial drying at high temperatures

Artificial drying at high temperatures is a technique widely used in farms, processing industries, collecting, and intermediate storage units worldwide. This type of drying is the fastest and does not depend on the place's climatic conditions [25].

According to [26], for medium and large quantities of grains, the technical drying systems are recommended (artificial drying system with forced ventilation), which are classified as stationary (with



axial or radial airflow), conventional (continuous) intermittent) and mixed (dryeration). Among these, the most used dryer in Brazil is the conventional continuous flow or cascade type [27].

### 3.2.1 Conventional continuous flow dryer

The Conventional continuous flow dryers, also called cascade type dryers, are the most popular because they contribute to better drying uniformity throughout the grain column since the entire width submits to the same air. All grains are mixed with the hot air as it passes through the dryer [28].

In the conventional continuous dryer (Figure 3), the drying air is distributed in the upper part of the drying column, with 2/3 of the column height, and the cold air (ambient air) is distributed in the lower part of the drying column, whose purpose is to remove the heat of the grain mass [29].

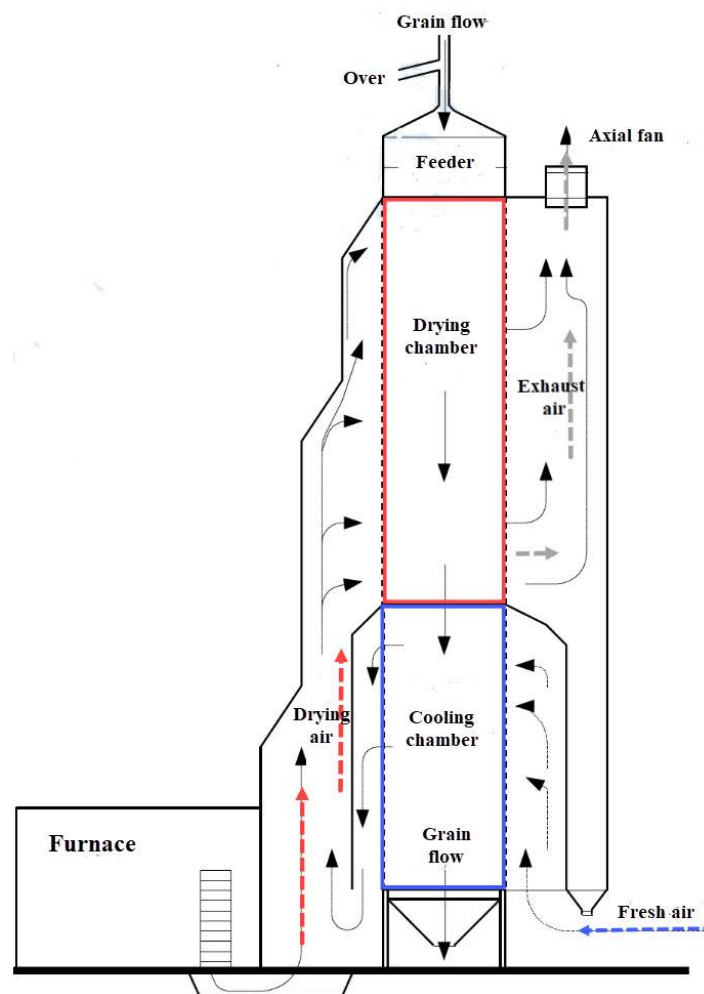


Figure 3. Conventional continuous flow dryer [27]

Fast cooling inside the continuous flow dryer results in a significant increase in stress cracks and susceptibility to breakage [30] generating environmental problems due to the emission of large amounts of particles in the form of husks and small pieces of grains, contaminating the surroundings of the reception and drying sector [31]; [32].

### 3.2.2 Dryeration systems

Discharging the hot and partially dried grains into a silo and delaying cooling allows the dry aeration process to be used. This process will reduce the number of grains broken by tension than conventional high-temperature continuous flow drying. Dry aeration was introduced to increase the dryer's capacity (uses the entire column as a drying chamber), improve energy efficiency, and increase the quality of grains [33]. The grain dry-aeration method was created in the United States in the 1960s by George Foster, a professor in the Department of Agricultural Engineering at Purdue University, Indiana [34].

Research on the new drying process called dry aeration (Dryeration) began in 1962. The first information was reported in the Purdue Farm Science Days survey in January 1964 [35]. Dryeration consists of drying with a conventional continuous high capacity dryer, accumulated in a metal silo for temperature equalization, followed by cooling in the same silo before transfer to final storage (Figure 4).

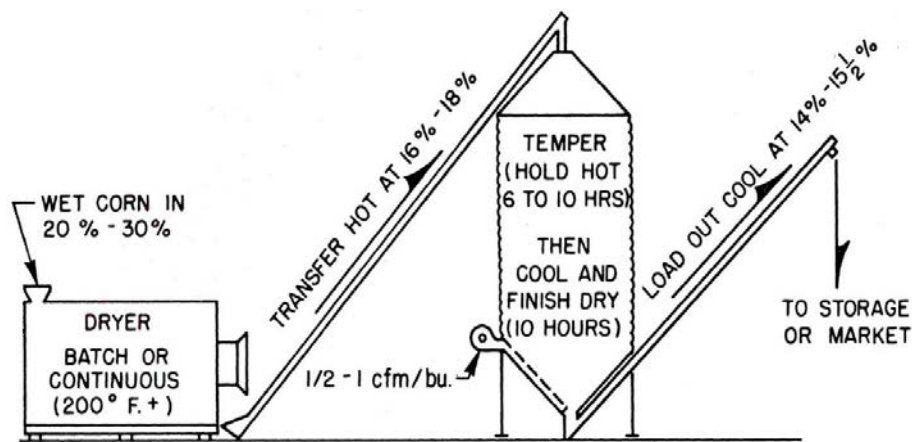


Figure 4. Dryeration system [35]

Figure 5 shows a flowchart of a grain receiving installation with a dryeration system.

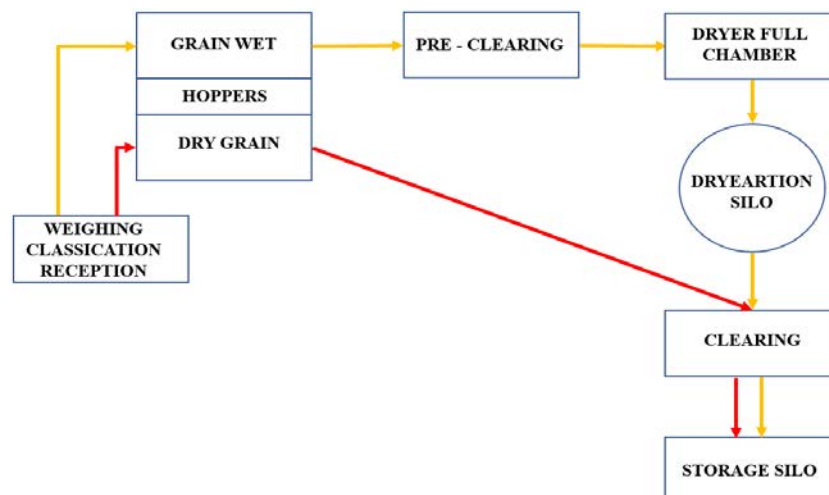


Figure 5. Grain receiving installation with a dryeration system

Reception, classification, and weighing is the initial stage of receiving the grains, where the moisture and impurity analyzes of the grains and weighing of the cargo are made. According to the moisture content contained in the grains, the load will be directed to wet grain hoppers or dry grains.

The dry grains will be sent directly to the cleaning sector for dry grains and then to the bulk carrier, where they will be stored.

The wet grains will be pre-cleaned in the pre-cleaning sector and will pass to drying in a full column dryer, being removed hot and sent to the aerator dryer silo where they will remain in maturation for 6 to 10 hours and then will cool with air at room temperature.

After maturation and cooling, the beans go to the cleaning sector and then go to the storage silo where they will be stored.

This system increases the drying capacity by 50 to 75% due to a series of factors: eliminating the cooling inside the dryer (Figure 4), where the entire column is used as a drying chamber, removing less humidity, and a significant increase in the amount of heated air used in the dryer [21].

[29] says that the great importance of the dryeration system is in increasing the dryers' real capacity, causing the reception problems at the peak of the harvest to decrease, the queues next to the grain unloading hoppers. The same author also states that the system represents the following gains:

- A significant increase in dryer capacity is much faster to dry a grain load from any initial moisture up to 16% (b.u.) than up to 13%. This 3% humidity, unless the dryer stops removing, can mean little water removed, but it represents an extended drying time because moisture will have to migrate from the center of the grain to its periphery.
- Capacity gain because the dryer does not cool the beans in the cooling chamber has become the drying chamber, increasing the drying capacity by 33% (or 1/3).

Because forced ventilation to cool the grains occurs after a reasonable time and in a large grain layer, there is practically no shedding and other solid residues, contributing to the environment's improvement.

Figure 6 shows a conventional continuous flow dryer, adapted for the dryeration system, working with a drying chamber in the dryer's entire body, without the cooling chamber. This adaptation consists of removing the ambient air guiding plates next to the cooling chamber and closing the ambient air inlet to the dryer, with insignificant costs compared to acquiring the dried product. In this way, the cooling chamber starts to receive drying air, transforming it into a drying chamber.

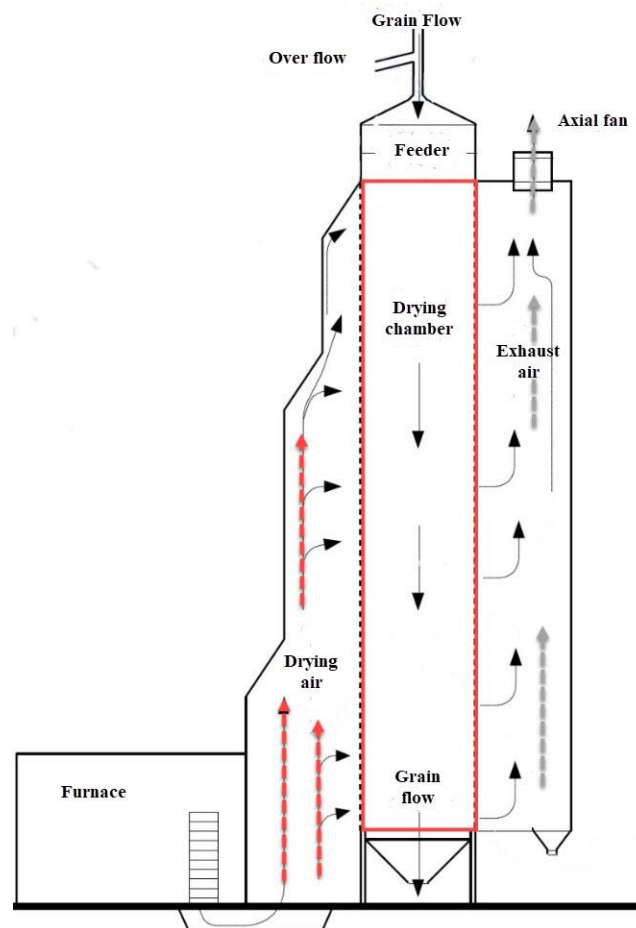


Figure 6. Conventional continuous grain dryer adapted for dryeration

The grain is discharged hot between 43 and 54 ° C from the dryer to a separate metal silo (Figure 7) without initial cooling and product moisture with two or three percentage points above the desired level. After equalization rest for 8 to 12 h, the grain is cooled with ambient air at an airflow rate of 0.5 to 1.0 m<sup>3</sup> / min x ton. Delayed cooling allows a large percentage of the corn's sensitive heat to be used to evaporate some of the remaining moisture.

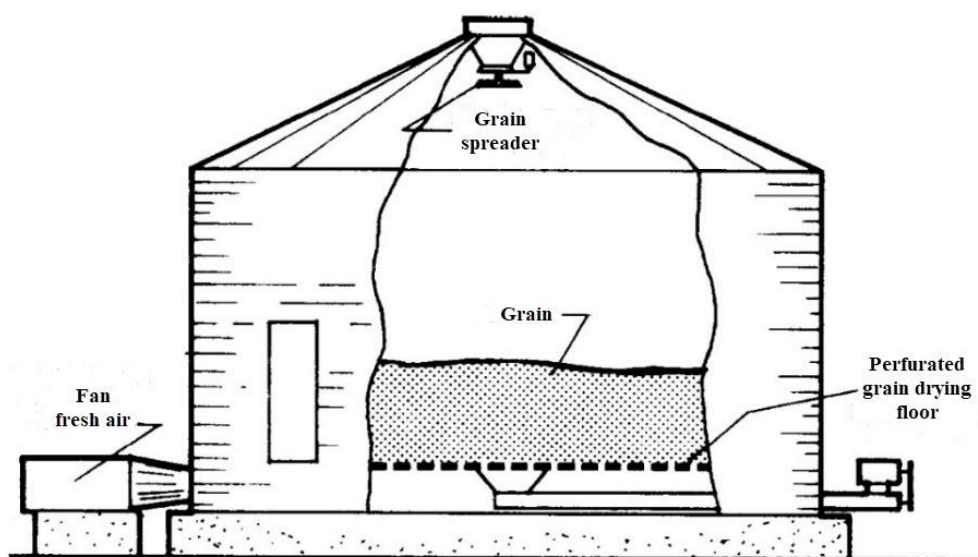


Figure 7. Equalization and drying metallic silo [36]

Vertical silos have a height more prominent than the diameter of one of the dimensions of the base. They are usually of metallic construction, constructed of corrugated sheets, of galvanized steel. They are equipped with aeration systems [37].

#### 3.2.2.1. Energy consumption

In the specific case of corn drying, in a properly designed dry aeration system, [23] state that a reduction of 25% to 15% (bu) in the moisture content, it results in an increase of around 50 % in the capacity of commercial dryers and, consequently, a 20 to 30% reduction in fuel consumption spent per ton of dry product.

Table 2 shows the drying air temperatures for each drying system, showing the lowest temperature used in the dry aeration system [38].

Grain	Drying systems		
	Batch	Continuous	Dryeration
Rice	70-115		60-80
Wheat	70-110	70-120	70-90
Corn	80-120	90-130	79-90
Soybean	80-120	90-130	79-90
Bean	80-100	80-110	60-80

Table 2. Drying air temperature at the entrance of different grain drying systems

The dryeration method provided an increase in the dryer's operational cadence, improved the utilization of the installations, and reduced energy costs in drying. Although these advantages were desirable for the sector, their limitations restricted their consolidation to industrial plants that contained the necessary equipment for their application [35].

#### 3.2.2.2. Drying quality

The grains suffer physical changes caused by a temperature and humidity gradient, which cause expansion, contraction, changes in density, and porosity, during the conventional drying process (continued). The conventional drying process significantly increases the percentage of broken grains and can cause internal or surface cracks, making them more susceptible to breakage during cleaning and storage [38].

The multiple tension cracks decrease from more than 40% to less than 10% when dryeration is compared to conventional high-temperature drying [39]. Confirming this statement, [40] highlights that the index of broken grains in conventional drying was 43.6%, while in dryeration it was 7.60%, with a significant reduction in damage to grains.

[41] analyzed the variables that can contribute to grain quality changes during drying. They found that the delayed cooling of the grains in the dry aeration process effectively reduces the possible susceptibility to breakage compared to conventional drying and cooling in a continuous dryer.

In general, dryeration provides better grain quality than other grain drying systems.

### 3.2.2.3. Environmental considerations

The main factor influencing Brazilian agribusiness's energy-environmental sustainability is the high dependence on thermal energy in the pre-processing of grains, mainly in drying [42].

Studies carried out in the State of Paraná point to firewood as the primary fuel used in drying the grains, reaching about 85% of the total demanded [42].

The use of firewood on a large scale as an energy source requires attention to the ways of obtaining this energy source since it would be necessary to implement large areas of reforestation in a monoculture that lead to other ecological problems of an ecological nature, as the decrease in biodiversity [43].

The dry aeration system, reducing energy consumption by 15 to 30% and increasing the drying capacity above 50%, provides a significant reduction of fuel for heat generation. Consequently, we will have a reduction in firewood consumption and a decrease CO<sub>2</sub> emissions.

### 3.2.2.4. Disadvantages of the dryeration systems

The disadvantages of dry aeration are the increased grain handling and additional equipment required for tempering. The silos need to be equipped with larger fans to provide air flows of at least 0.5 m<sup>3</sup> / min x ton.

Table 3 shows the comparison of airflow values indicated by the type of drying installation [44].

Installation type	Air Flow (m <sup>3</sup> / min.ton de produto)
Ventilation - flat bulk warehouse	0,10 a 0,20
Ventilation - Silo	0,03 a 0,10
Ventilation - unprocessed grain Silo	0,30 a 0,50
Dryeration	0,50 a 1,00
Colling	mínimum 0,12

Table 3. Airflow recommendation for grain aeration [43]

## 4. Conclusions

Drying plays an essential role in improving agricultural products' quality, improving storage conditions, and increasing storage times.

Drying methods that minimize fuel consumption with increased thermal yield and have low environmental degradation should reduce the drying cost, increase the drying flow, and preserve the environmental resources.

The dry aeration system has shown significant gains in drying capacity, increased energy efficiency with reduced fuel consumption, improved product quality with a significant reduction in grain breakage, and reduced environmental impact due to drying.



## 5. References

- [1] Rasi, J. R., Bernardo, Roberto., Mazer, Wellington., Serafim, J. A., Bachega, L. A. Proposal for Modular Precast Bulk Warehouse for Brazilian Agricultural. International Journal for Innovation Education and Research (IJIER), vol. 8, nº.11, 2020. <https://doi.org/10.31686/ijier.vol8.iss11.2758>
- [2] Companhia Nacional de Abastecimento – CONAB. Available at <https://www.conab.gov.br/ultimas-noticias/3652-producao-de-graos-deve-superar-268-milhoes-de-toneladas-na-safra-2020-21>
- [3] Baroni, G. D., Benedeti, P. H., Seidel, D. J. Cenários prospectivos da produção e armazenagem de grãos no Brasil. Revista Thema - **Instituto Federal de Educação, Ciência e Tecnologia Sul-rio-grandense (IFSul)**, vol. 14, nº. 4, Pelotas, 2017 <http://dx.doi.org/10.15536/thema.14.2017.55-64.452>
- [4] Buckling, R., Thompson, S., Montross, M., Abdel-Hadi, A. Grain Storage Systems Design, Handbook of Farm (Second Edition), Chapter 7. Dairy and Food Machinery Engineering, ScienceDirect, 2013. <https://doi.org/10.1016/B978-0-12-385881-8.00007-0>
- [5] Coradi, P. C., Milane, L. V., Andrade, M. G. O, Camilo, L. G, Souza, A. H. S. Secagem de grãos de milho do cerrado em um secador comercial de fluxos mistos. Brazilian Journal of Biosystems Engineering vol. 10, nº 1, Chapadão do Sul, 2016. <http://dx.doi.org/10.18011/bioeng2016v10n1p14-26>
- [6] Elias, M. C., Oliveira, M., Vanier, N. L. Tecnologias de pré-armazenamento, armazenamento e conservação de grãos. Lab de Pós Colheita – UFPel, 2017. Available at <http://labgraos.com.br/manager/uploads/arquivo/material---prova-1.pdf>
- [7] Ludke, M. & Andre, M. E. D. A. Pesquisas em educação: uma abordagem qualitativa. Editora E. P. U. F. São Paulo, 2013.
- [8] Köche, J. C. Fundamentos da metodologia científica: teoria da ciência e iniciação à pesquisa. Editora Vozes, Petrópolis, RJ, 2011.
- [9] Souza, C. M. A., Queiroz, D. M., Lacerda Filho, A. F. Simulação do processo de secagem de sementes de milho em camada fixa. Revista Scientia Agrícola, v.59, n.4, p.653-660, 2002. Available at <file:///C:/Users/1513%20IRON/Downloads/21780-Article%20Text-25412-1-10-20120528.pdf>
- [10] Mujumdar, A. S., Law, C. L. Drying Technology: Trends and Applications in Postharvest Processing. Food Bioprocess Technol nº 3, 2010. <https://doi.org/10.1007/s11947-010-0353-1>
- [11] Christiansen, C. M., Kaufmann, H. H. Microflora. In: Storage of Cereal Grains and Their Products, second ed. Amer. Assoc. of Cereal Chemists, St. Paul, 1974.
- [12] Navarro, S., Noyes, R. The Mechanics and Physics of Modern Grain Aeration Management. CRC Press, Boca Raton, 2002.
- [13] Lutly, O. F., Mohd Noor, S. B., Abaas, K. A., Marhaban, M. H. Some control strategies in agricultural grain driers: A review. Journal of Food, Agriculture & Environment, vol. 6, nº 2, Finland, 2008. Available at [https://www.academia.edu/2527201/Some\\_control\\_strategies\\_in\\_agricultural\\_grain\\_driers\\_A\\_rview](https://www.academia.edu/2527201/Some_control_strategies_in_agricultural_grain_driers_A_rview)
- [14] Rasi, J. R., Bernardo, Roberto., Pelloso, J. A. C. Avaliação de um secador de bagaço de cana com dois estágios de secagem que utiliza o calor residual de um gerador de vapor: um estudo de caso. Brazilian Journal of Development, vol. 6, nº 8, Curitiba, 2020. <https://doi.org/10.34117/bjdv6n8-155>
- [15] Park, K. J; Antonio, G. C; Oliveira, R. A. Park, K. J. B. Conceitos de processo e equipamentos de

secagem. Desenvolvimento de material didático – FEAGRI, Unicamp, 2007. Available at

[http://www.feagri.unicamp.br/ctea/manuais/concproceqsec\\_07.pdfprojpesq.html](http://www.feagri.unicamp.br/ctea/manuais/concproceqsec_07.pdfprojpesq.html)

[16] Turnnermann, H. Metodologia para dimensionamento de um equipamento para secagem da vagem verde de soja e seus resíduos. Dissertação de mestrado. Universidade de Passo Fundo, 2018. Available at

<http://tede.upf.br/jspui/bitstream/tede/1856/2/2018HerbertTunermann.pdf>

[17] Trindade, M. S. Secagem de soja em camada espessa: modelagem matemática e simulação numérica. Dissertação de mestrado. Universidade Regional Noroeste do Estado do Rio Grande do Sul, 2013. Available at

<https://bibliodigital.unijui.edu.br:8443/xmlui/bitstream/handle/123456789/1674/DISSERTA%C3%87%C3%83O%20MARCELO%20TRINDADE.pdf?sequence=1&isAllowed=y>

[18] Silva, J. S., Afonso, A. D. L., Donzelles, S. M. L. Estudo da secagem em camada espessa: curso básico – Cap. 6 – Universidade Federal de Lavras, 2010. Available at

[file:///C:/Users/1513%20IRON/Downloads/cap6%20\(1\).pdf](file:///C:/Users/1513%20IRON/Downloads/cap6%20(1).pdf)

[19] Silva, L. C. Unidades armazenadoras – Secagem de grãos. Boletim Técnico AG: 04/05, Universidade Federal do Espírito Santo, 2005. Disponível em: [www.agais.com](http://www.agais.com)

[20] Parde, S. R., Jayas, D. S., White, N. D. G. Grain drying: A review. Sciences Des Aliments, nº 23, Editora Lavoisier, 2003. Available at [https://sda.revuesonline.com/gratuit/SDA23\\_5-6\\_589-622.pdf](https://sda.revuesonline.com/gratuit/SDA23_5-6_589-622.pdf)

[21] Montross, M. D., Maier, D. E. Simulated performance of conventional high-temperature drying, dryeration, and combination drying of shelled corn with automatic conditioning. Transactions of the ASAE 0001-2351/00, 2000. <https://doi.org/10.13031/2013.2751>

[22] Garcia, D. C., Barros, A. C. S. A., Peske, S. T., Menezes, N. L. A secagem de sementes. Ciência Rural, Santa Maria, vol. 34, nº 2, 2004. <https://doi.org/10.1590/S0103-84782004000200045>

[23] Silva, J. S., Afonso, A. D. L., Donzelles, S. M. L. Pós colheita de produtos agrícolas: curso básico – Cap. 5 – Universidade Federal de Lavras, 2010. Available at

<file:///C:/Users/1513%20IRON/Downloads/Cap%C3%ADtulo%205.pdf>

[24] Reykdal, O., Drying and storing of harvested grain – A review of methods. Skýrsla Matís 05-18, Iceland, 2018. <https://doi.org/10.13140/RG.2.2.14530.89286>

[25] Silva, J. S. Secagem e armazenagem de produtos agrícolas. Editora Aprenda Fácil, Viçosa, 2008

[26] Oliveira, V. Avaliação energética e econômica da secagem de grãos utilizando secador de coluna com caldeira aquatubular. Dissertação de mestrado. Universidade Estadual do Oeste do Paraná, 2014. Available at <http://tede.unioeste.br/bitstream/tede/785/1/DissertacaoVanderleyOliveira.pdf>

[27] Silva, L. C. Unidades armazenadoras – Secagem de grãos. Boletim Técnico AG: 04/05, Universidade Federal do Espírito Santo, 2005. Available at [www.agais.com](http://www.agais.com)

[28] Santana, P. A., Lopes, D. C., Steidle Neto, A. J. High-temperature grain drying: an economic analysis applied to Brazilian conditions. Open Access Journal of Science, vol. 4, nº 1, 2020. Available at <https://medcraveonline.com/OAJS/OAJS-04-00146.pdf>

[29] Weber, E. A. Excelência em beneficiamento e armazenagem de grãos. Editora Salles, Canoas. 2005.

[30] Foster, G. H. e Thompson, R. A. Stress cracks in artificially dried corn. United State Department of Agriculture – Purdue University, 1961. Available at

<https://www.ars.usda.gov/ARSEUserFiles/30200525/9%20Stress%20Cracks%20in%20Artificially%20Dried%20Corn.pdf>

[31] Rasi, J. R. Proposta de programa de gestão ambiental para agroindústria. Monografia de especialização em Saneamento Ambiental. Universidade Gama Filho, Rio de Janeiro, 2009. <https://doi.org/10.13140/RG.2.2.10409.21603>

[32] Silva, L. C. Unidades armazenadoras – Impactos ambientais. Boletim Técnico AG: 09/05, Universidade Federal do Espírito Santo, 2015. Available at [www.agais.com](http://www.agais.com)

[33] Foster, G. H. Dryeration - A corn drying process. U.S. Dept. of Agriculture Marketing Service Bull. No. 583. Washington, 1964.

[34] Rocha, J. C. Da, Parâmetros industriais e tecnológicos do arroz na seca-aeração e no armazenamento. Dissertação de mestrado. Universidade Federal de Pelotas, 2010. Available at <http://guaiaca.ufpel.edu.br:808/handle/123456789/1332>

[35] McKenzie, B. A., Foster, G. H., DeForest, S. S. Dryeration and bin cooling systems for grain. AE-107, Ind.: Cooperative Extension Service, Purdue University, 1967. Available at <https://www.extension.purdue.edu/extmedia/AE/AE-107.html>

[36] Freisen, O. H. Heated-air grain dryers. Publication 1700. Manitoba Department of Agriculture, Winnipeg, 1980.

[37] Rasi, J. R. Alternativas estruturais em paredes de concreto pré-moldado de silos horizontais. Dissertação de mestrado – Universidade Federal de São Carlos, UFSCAR, São Carlos - SP, 2014. Available at <https://repositorio.ufscar.br/handle/ufscar/4699>

[38] Villela, F. A. Efeitos da secagem intermitente sobre a qualidade do milho. Tese de doutorado. ESALQ/USP, 1991. <https://doi.org/10.11606/T.11.20191220-122957>

[39] Foster, G. H. Dryeration: Heated air drying and corn quality. In: Annales de Techonogie Agricole, vol. 22, nº 3, Reprints Collection, 1973. Available at [https://archive.org/stream/dryerationcorndr53fost/dryerationcorndr53fost\\_djvu.txt](https://archive.org/stream/dryerationcorndr53fost/dryerationcorndr53fost_djvu.txt)

[40] McKenzie, B. A., Foster, G. H., DeForest, S. S. Dryeration and bin cooling systems for grain. AE-107, Ind.: Cooperative Extension Service, Purdue University, 1967. Available at <https://www.extension.purdue.edu/extmedia/AE/AE-107.html>

[41] Gustafson, R. J., Morey, R. V. Study of Factors Affecting Quality Changes During High-Temperature Drying. Transactions of the ASAE 0001 -2351/79, 1979. <https://doi.org/10.13031/2013.35128>

[42] Errera, M.R., Stanescu G. and Filipini, F.A. Relatório parcial em tecnologia de processamento de soja e o potencial de integração de cogeração para o gás natural, Projeto FINEP/CETPETRO #0660/01, UFPR, Curitiba, 2002.

[43] Marques, B. A. Considerações ambientais e exegérticas na fase de pós-colheita de grãos: estudo de caso do Paraná. Dissertação de mestrado UFPR, 2006. Available at [https://docs.ufpr.br/~bleninger/dissertacoes/114-Breno\\_de\\_Almeida\\_Marques.pdf](https://docs.ufpr.br/~bleninger/dissertacoes/114-Breno_de_Almeida_Marques.pdf)

[44] Silva, L. C. Unidades armazenadoras – Aeração de grãos armazenados. Boletim Técnico AG: 01/11, Universidade Federal do Espírito Santo, 2014. Disponível em: [www.agais.com](http://www.agais.com)

# **Ten golden lessons from Republic of China (Taiwan), the best country to save lives during 305 days battle against Covid-19**

**Dr. Jonas Gomes da Silva ([jgsilva@ufam.edu.br](mailto:jgsilva@ufam.edu.br) or [jonas.gomesdasilva@manchester.ac.uk](mailto:jonas.gomesdasilva@manchester.ac.uk))**

Associate Professor at the Industrial Engineering Department of FT/UFAM – Eureka Laboratory

Manaus – Amazon – Brazil

Research Visitor at the MIOIR – Alliance Manchester Business School

The University of Manchester – United Kingdom

## **Abstract**

*1.82 million lives were officially lost by Covid-19 until last 31st December 2020 (WORLDOMETERS, 2020), a year with an intense global battle against the pandemic, with many countries eager to learn from benchmark nations able to save lives. A new methodology developed by Silva (2020b), with fifteen phases, showed that among 108 well-evaluated countries, the top six benchmark countries against Covid-19 are from Asia with emphasis on Vietnam, Taiwan, and Thailand. To complement Silva's (2020b) study, this article aims to investigate the performance and the best management practices adopted in Taiwan to save lives, during the first ten months facing the pandemic. The research is descriptive, uses an online questionnaire with bibliographic and documentary approaches. The Fatality Total Index (FTI) developed by Silva (2020b p. 563) was used to compare Taiwan's performance against 43 semifinalist countries. Some results are: 1) Taiwan's FTI305 is the lowest because of National Government leaders ability to improve the country legal, health care, and industrial systems, as well as integrate and support main actors of the nation to prevent, prepare and control the Covid-19; 2) for 109 respondents living in Taiwan, the ten main policy measures adopted by the National Government that saved lives against the virus are: international travel control, effective public-private collaboration, public information campaigns, integration with mass media, increase the medical and personal equipment capacity, combat fake news, public event cancellations, improve intensive care unit structure, support the expansion of the testing system, and schools closures. At the final, ten golden lessons are provided, from Taiwan Models and 250 policies, measures, programs, projects, strategies, innovative products or services identified, with the majority led by the Public Sector, Corporations, followed by Others, Start-Up and Universities.*

**Keywords:** Best management practices; Covid-19; FTI; Innovation; Lives; Policy; Technologies

## **1. Introduction**

Last 31st December 2020 completed one year of the intense global battle against a virus called by the World Health Organization (WHO, 2020) as Coronavirus disease, a Severe Acute Respiratory Syndrome Coronavirus2 (SARS-CoV-2), known as Covid-19.

Taking into consideration the number of total cases reported, 90 days since the first case, on March 31, 2020, USA, Italy, China, Spain, Germany, France, Iran, UK, Switzerland, and the Netherlands were the 10 most critical nations (SILVA, 2020a). In April/20, Silva (2020a): concluded that b1) Brazil could be among the most-affected country before ending May/20; b2) although no nation is prepared to face epidemics and pandemics (NTI, JHU, and EIU, 2019), among the sixteen countries, investigated, Thailand, Finland, Australia, South Korea, Denmark, and Sweden are cases that Brazil could study so as not to repeat the scenarios of China, USA, Italy, and Spain; b3) the research focused only the number of new cases per day, so it was recommended a study involving **the fatal cases**.

Considering the number of fatal cases, the world surpassed one million reported deaths on 27th September 2020, with the USA, Brazil, India, Mexico, UK, Italy, Peru, France, Spain, and Iran considered the most critical countries. In that time, Silva (2020b) developed a holistic methodology to identify 20 benchmark countries that are saving lives against Covid-19. As a result, the fifteen phases of the methodology, far from perfect, show that among 108 well-evaluated countries, the top six benchmark nations are from Asia (Vietnam, Taiwan, Thailand, China, Malaysia, and Singapore), which suffered from fatal cases from SARS-CoV in 2002/2003, followed by South Korea, New Zealand, Australia, Japan, Hong Kong, Cyprus, Greece, Latvia, Iceland, United Arab Emirates, Czech, Lithuania, Norway, and Estonia. That research did not focus on the policies, measures, programs, projects, innovations, and cultural aspects that were adopted by each country over time, **reason by which further research was recommended to identify, and disseminate them** (SILVA 2020b p. 568).

To complement Silva's (2020a) study, last November/20, another research (GOMES DA SILVA, 2020) was published focused on Thailand's performance and the best management practices adopted to save lives against Covid-19, during the first 180 days facing the pandemic. Besides, this study is part of a research package that is investigating the performance and good practices adopted by each country considered as a benchmark by Silva (2020b).

So, to continue the package research, this article aims to investigate the performance and the best management practices adopted in Taiwan to save lives, during the first 305 days facing the pandemic.

The specific objectives are a) to present WHO models and Taiwan Strategic Preparedness and Response Plan for Pandemic; b) to present Taiwan Models for combating the Covid-19; c) to investigate Taiwan main leaders background; d) to compare Taiwan's performance against 43 semifinalist countries identified by Silva (2020b); e) to identify the best management practices adopted in Taiwan, taking into consideration cultural practices, main policy measures, programs, projects, strategies, and innovative solutions.

The research is relevant for WHO, Centers for Disease Control and Prevention (CDC), Presidents, Ministers, Managers, Entrepreneurs, since they will know the non-pharmaceutical practices developed by Taiwan during the first 10 months fighting the pandemic. Furthermore, it can be useful to develop strategies for preventing or controlling similar pandemic episodes in the future.

Also, for the academy, it can be useful for the teaching process and the development of new research, especially related to non-pharmaceutical interventions on Covid-19. Although several authors have published relevant information about Coronavirus (COWLING et al., 2020; CUI et al 2003; CHUANG et al, 2020; FLAXMAN et al., 2020; GOMES DA SILVA 2020; HA et al., 2020; LA et al., 2020; KAN et



al. 2005; JIAN et al 2017; JIAN et al 2020; SILVA, 2020a; SILVA, 2020b; PANG 2003; ZAMBRANO-MONSERRATE, RUANO, AND SANCHEZ-ALCALDE, 2020; SVOBODA et al. 2004; YEH AND CHENG, 2020; YEN et al 2011; WANG, NG, AND BROOK, 2020), there is a need to compare the performance evolution of a benchmark country against other well-evaluated nations, taking into consideration the real estimated number of Covid-19 fatal cases by one million population during the first 10 months facing the pandemic, as well as to provide a more complete study on the models, cultural aspects, policy measures, programs, projects, strategies, and innovative solutions adopted over time.

## 2. Best Management Practices (BMP)

Management practice is considered by some authors as an entity of analytical instruments used to support the managers at work during the execution of the selected management concept (DESSLER, 2004; SUTHERLAND and CANWELL, 2004; VAN ASSEN et al., 2009). Others consider the term as tools that are defined as a set of concepts, processes, and exercises (RIGBY, 2001).



Figure 1: BMP instruments classification related to Health and/or Covid-19

Source: Gomes da Silva (2020 p. 124)

For this research, Best Management Practices (BMP) is defined as those acceptable and effective management instruments able to achieve the goal(s) creatively and sustainably (GOMES DA SILVA 2020 p. 124). The instrument could be classified into 3 levels: International, National, and Regional/Local, as shown in Figure 1.

According to Gomes da Silva (2020 p. 124), at the International level, there are international evaluation systems such as the Health-related Sustainable Development Index (GBD 2017 SDG



COLLABORATORS, 2018), NUMBEO Health Care Index (NUMBEO 2020), Covid-19 Regional Safety Assessment (Deep Knowledge Group (2020), all of them related to Health or Covid-19. At the National level, there are Government or Legislative policies, measures, programs, projects, package, act, law amendment, regulations, and at the Regional/Local level, there is methodology, method/technique, innovation, process, campaign, project, a set of values, or culture developed by Companies, Local Governments, Universities, Startups, and NGOs.

### **3. Infectious diseases in the last decades before Covid-19**

Despite global medical and scientific advances, infectious diseases are still a major cause of mortality and morbidity, disability, and socioeconomic upheaval worldwide (PRILYTSKY et al, 2011).

Infectious diseases are classified in several ways, one way is related to the spatial, temporal distribution of the novel infection disease, as well as the number of people affected, starting from the low level, called endemic until a pandemic.

In simple terms, an endemic is something that belongs to a particular people or country. An outbreak is a greater-than-anticipated increase in the number of endemic cases, if it's not quickly controlled, an outbreak can become an epidemic. An epidemic is a disease that affects a large number of people within a community, population, or region. A pandemic is an epidemic that's spread over multiple countries or continents (INTERMOUNTAIN HEALTHCARE, 2020).

Between 1980 and 2013, 12102 outbreaks of 215 (74% non-vector and 25% vector transmitted) human infectious diseases affected more than 44 million in 219 nations. Concerning the taxonomy of 215 infection diseases, bacteria and virus are more common than parasites, fungi, and protozoans, 80 (37%) are from bacteria which generated 5848 (48%) outbreaks, while 70 (33%) are from the virus which generated 4901 (40%) outbreaks around the world. Finally, at least 150 pathogens that affect humans have been identified as emerging, re-emerging, or evolving since the 1980s (SMITT et al, 2014; BEDFORD, et al 2019).

Data collected from Global Infectious Disease and Epidemiology Online Network (GIDEON) database showed that between 1980 and 2010, the number of outbreaks is growing by a decade, from 991 (1980-1990) to 3420 (2010-2020), with zoonoses related representing a total of 3462 outbreaks, while human-related equal to 2873 outbreaks. In terms of Zoonoses, among the 13 diseases, Salmonellosis (855), Escherichia coli diarrhea (460), Hepatitis A (391), Shigellosis (314), Tuberculosis (271), and Dengue fever (245) were the most representative. When Human-specific cases are analyzed, among the 14 diseases, Gastroenteritis (viral = 536), Measles (467), Cholera (432), Enterovirus infection (350), Legionellosis (249), Meningitis (bacterial=246) were the most representative (SMITT et al 2014).

During last decades, the human being faced several challenges with pandemic and epidemic related to Chikungunya, Crimean-Congo hemorrhagic fever, Ebola virus disease, Lassa fever, MERS-CoV disease, Marburg hemorrhagic fever, Nipah virus infection, Rift Valley fever, SARS-CoV disease, Severe fever with thrombocytopenia syndrome, and Zika virus. All of them were considered as a priority to receive Research and Development by the Workstream1 group that participated at the World Health Assembly realized in May 2016 (WHO, 2016 p.3).

For example, in April 2009, a new influenza virus (H1N1) emerged in the USA and spread quickly around the globe. After two months, on June 11th, 2009, the WHO declared it as the first flu pandemic in 40 years. According to the CDC (2019), between 151,700 and 575,400 fatal cases were estimated during the first year the virus circulated the globe. Another example is the epidemic of SARS-CoV that appeared in Nov/2002 in southern China. According to WHO (2012), from the first day of November 2002 until July 31, 2003, it probably affected 8096 people in 29 countries with a total of 774 fatal cases (9.56%), mostly located in Asia, such as China (5327 cases; 349 deaths), HK (1755 cases; 299 deaths), Taiwan (346 cases; 37 deaths), and Singapore (238 cases; 33 deaths) with an estimated total GDP loss in 2003 for the four economies amounted to about US\$13bn (WHO, 2016 p.5).

Since 2003, many progress have been made by organizations such as WHO and CDC to provide guidance, standards to face the pandemics with several authors (HOLMES, 2003; PANG, 2003; WATTS, 2003; BELL, 2004; INSTITUTE OF MEDICINE, 2004; YEN et al, 2011; YEN et al, 2014) providing information about the SARS-CoV and called the attention of the decision-makers about measures necessary to prevent, control, and respond to future global outbreaks.

#### **4. Fast preventive and control responses of Taiwan against Covid-19 pandemic**

Despite the advice, guidance, and standards provided by WHO, CDC, and specialists, seventeen years later, on December 31, 2019, a new alert appeared.

From a Taiwanese 25 years old free online platform, called PTT Bulletin Board System (Figure 2), Taiwan Center for Disease Control (TCDC) leaders accompanied a heated discussion and learned that at least seven cases of pneumonia infections on unknown cause had occurred in Wuhan (China).

The hot discussion with documents shared by the participants raised several worries such as the possibility of SARS return again, the need to prepare the mask, the return of Taiwanese businessman from China to Taiwan may cause large infection, the alert of Health Ministry, the explosion of cases, the coming Spring Festival with 130,000 compatriots, the necessary funds, the collapse of house prices, Taiwan prevention measures, etc.

On the same day, using International Health Regulations Mechanism, after contact and receive feedback from WHO, Taiwanese authorities deduced that there was a strong possibility of human-to-human transmission from the Wuhan reported disease, reason by which, from December 31, 2019, the National Government and partners started preventive and control measures, some of them shown in Chart 1.

In other words, Chart 1 shows that before the Covid19 was declared a pandemic by WHO on March 11, 2020, Taiwan leaders adopted several legal, administrative, financial, and technological measures against the virus since December 11, 2019.

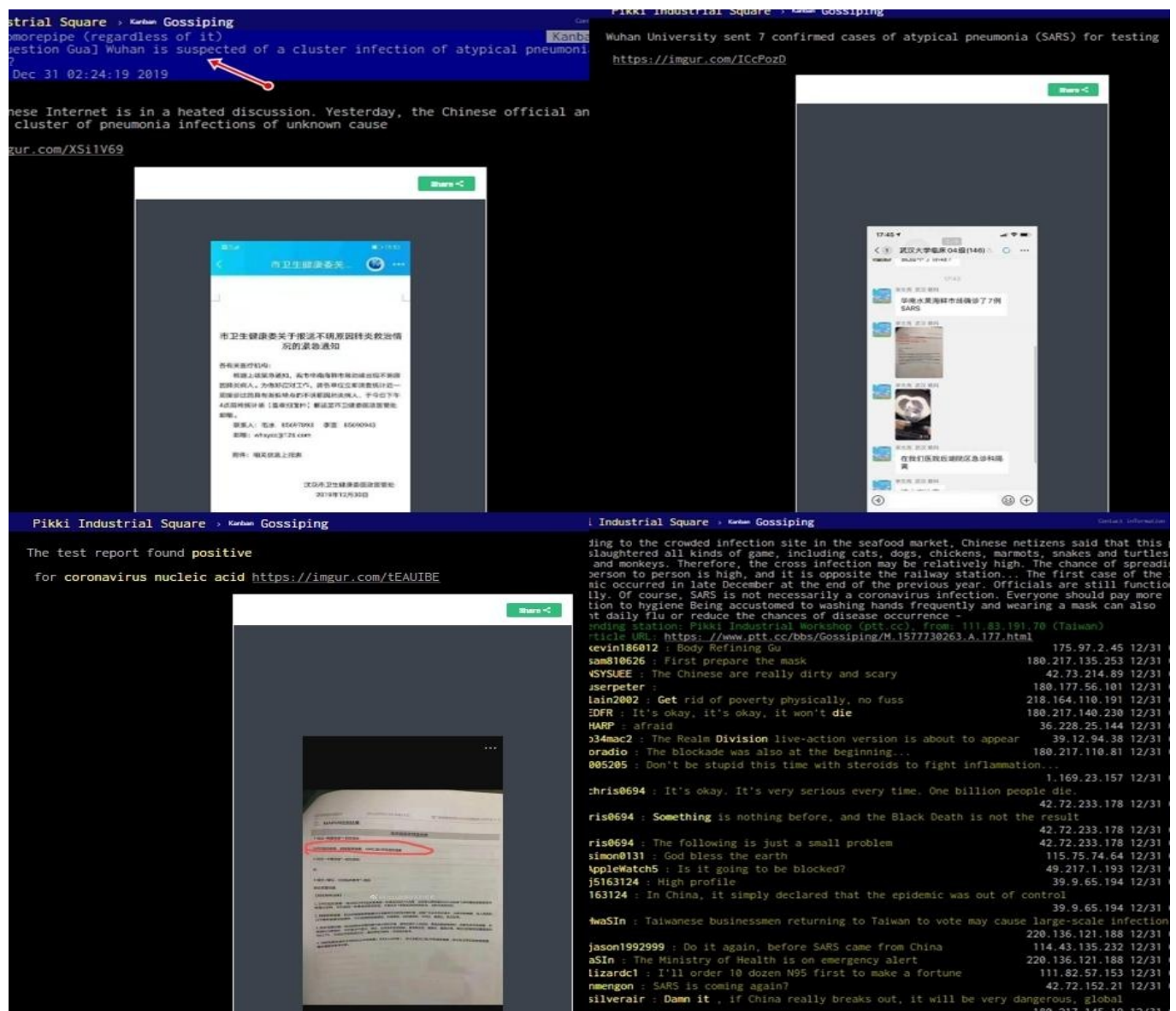


Figure 2: Shared documents and discussion about a suspected cluster infection of atypical pneumonia in Wuhan – Tuesday (02:21:19) December 31, 2019  
Source: PPT (2019)

MEASURES	TYPE	WHEN
Implement onboard quarantine inspection of direct flights from Wuhan, China, and promoted related prevention measures among other travelers.	Prevention	Dec/31/19 Jan/23/20
Set up TCDC team to deal with the mystery pneumonia in Wuhan	Operational	Jan/02/20
Realize surveillance and Laboratory Diagnosis to identify people with fever, cough, or other respiratory symptoms, improving the laboratory diagnosis capacities from 12 laboratories (520 cases/day) to around 50 labs (6K/day)	Prevention	From Jan/02/20
TCDC classified the new coronavirus as Category 5, based on Communicable Disease Control Act (CDCA), to strengthen surveillance and containment of the virus. It helped urge the public and medical facilities to take notice of the disease and take necessary precautionary measures to decrease the risk of transmission.	Legal	Jan/15/20

Continuation of Chart 1

MEASURES	TYPE	WHEN
Use of legal basis of the CDCA to activate the Central Epidemic Command Center (CECC), to centralize actions, decide the level, the commander, and other epidemic control actions.	Legal	Since Jan/20/20
Establish level 3 of the CECC to integrate resources of the administration, the academic, medical, and private sector, under the leadership of Jih-Haw Chow, Director-General of TCDC.	Operational	Jan/20/20
Confirm the first case of Covid-19 in Taiwan, a 50-year-old woman, who travel to Wuhan, identified at Taipei's International Airport and sent to the hospital.	Prevention	Jan/21/20
After the confirmation of the first case, establish level 2 of the CECC, Shih-Chung Chen, the Minister of Health and Welfare (MOHW) served as the commander to coordinate and mobilize resources from a cross-ministry perspective, including the ministries of interior, transportation, foreign affairs, economics, labor, education, environment, etc. as well as private stakeholders to fight against new coronavirus.	Operational	Jan/23/20
Ban the mask export from Jan/24 to May 31/20.	Prevention	Jan/24/20
Advise citizens abroad against non-essential travel and to those traveling to China to avoid traditional health facilities and market	Prevention	Jan/24, 25/20
Advise people with fever, cough, or shortness of breath to stay at home	Prevention	Jan/24/20
Require new coronavirus contacts to follow preventive health measures	Prevention	Jan/26/20
President Tsai spoke about the new virus potential economic impact, and government contingency measures to fight the pandemic as if fighting a war.	Prevention	Jan/30/20
Require travelers arriving in Taiwan to voluntarily inform the quarantine officer at the airport or port if they have the new covid-19 symptoms, as well as orientation about how to proceed in the case to develop with 14 days the symptoms.	Prevention	Jan/30/20
Develop rigorous isolation and quarantine measures for Taiwanese businessmen returning from Wuhan	Prevention	Feb/03/20
Banned international cruise ships from calling at ports of Taiwan from Feb/06	Prevention	Feb/06/20
Taiwan Machine Tool & Accessory Builders' Association encouraged the companies members to volunteer and help the country to produce masks. The first "National Mask Team" troop was set up in just five days. Many companies joined on February 21 to support Taiwan's mask equipment manufacturers.	Operational	Feb/06/20
Suspend all flights to China, except to and from Beijing Capital Int. Airport, Shanghai Pudong Int. Airport, Shanghai Hongqiao Int. Airport, Xiamen Gaoqi Int. Airport and Chengdu Shuangliu International Airport.	Prevention	Feb/07/20
Require home quarantine for travelers granted entry into Taiwan that are transiting through China, Hong Kong, and Macau	Prevention	Feb/07/20
Require travelers arriving from areas outside Macau, HK, China to complete a health declaration form, stating their travel and contact history over the previous 14 days. Those who provide inaccurate information or refuse to provide information will be fined up to NT\$ 150,000.	Legal	Feb/11/20

## Continuation of Chart 1

MEASURES	TYPE	WHEN
WHO announced as a new virus of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) with a popular disease name as Covid-19	-	Feb/11/20
WHO launched a draft of Covid-19 Strategic Preparedness and Response Plan with operational planning guidelines to support countries preparedness and response	-	Feb/12/20
Start the use of a Health Declaration and Home Quarantine E-System (Entry Quarantine System) to facilitate the life of travelers with mobile phone	Operational	From Feb/16/20
The Minister of Economic Affairs created and coordinated the National Mask Team to increase production, and consolidate domestic enterprises including raw material suppliers and manufacturers to assist in producing supplies to prevent disease. The government drew up a budget of NT\$200 million (US\$6.6 million) to build 60 face mask production lines, they were completed in 25 days, which enabled daily mask production to be increased from 1.88 million to 10 million by Mid-March and 19 million until ending of April 2020.	Financial Aid and Operational	From Feb/21//20
Use smart technologies to track people under home quarantine and inform them those who violate home quarantine requirements will be fined up to NT\$150,000	Legal	Feb/24/20
Advises to travelers arriving in Taiwan from Thai, Italy, Iran, Singapore, and Japan, to conduct self-health management of 14 days.	Prevention	Feb/24/20
President Tsai promulgated the Special Act on COVID-19 Prevention, Relief, and Restoration by presidential decree No. 10900021291. It has 19 articles for effectively contain Covid-19, safeguard public health, and cope with associated impacts on the domestic economy and society. The MOHW said a special budget of NT\$ 60bi (US\$1.97 bi) has been set aside for the act and is pending review by the Legislature.	Legal and Financial Aid	Feb/24/20
Due global epidemic situation getting worse, level 1 of the CECC was established, the Premier appointed Shih-Chung Chen, the Minister of MOHW, as the commander to coordinate and mobilize resources across ministries and from the private sector to fight against Covid-19.	Operational	Feb/27/20
The MOHW published the Covid-19 plan with preparatory and contingency phases in response to the global pandemic	Operational	Feb/28/20
Taipei Mass Rapid Transit refuse entry into metro stations for people with high temperatures (over 38 degrees)	Prevention	Feb/29/20
Taiwan High-Speed Rail canceled non-reserved seats for April 1-6, which includes the Tomb-sweeping Festival holiday, to reduce the number of passengers per train.	Prevention	Mar/04/20
Start to test the Name-Based Mask Distribution System 1.0, the CECC announced that the first round of online orders beginning on March 12 constitute a trial run, with an estimated 7 million face masks (equal to the weekly allotment of 2.33 million people) being made available	Operational	Mar/10/20
The CECC is paying individuals subject to quarantine a stipend of US\$33.33 for each day of their 14-day quarantines. Those on paid leave or who violate quarantine regulations are not eligible to receive compensation.	Financial Aid	Mar/11/20
WHO announced Covid-19 as a pandemic	-	Mar/11/20

Chart 1: First measures taken by Taiwan Government and partners against the Covid-19 until 03/11/20

Sources: MOFA (2020), Policy (2020), TCDC (2020) and TCDC (2020b)



## 5. Fast transmission of Covid-19

According to Silva (2020a), at 18:32 (GMT) on March 29, 2020, the Worldometers pointed out 710,950 confirmed cases with 33,553 deaths. In that time, while Taiwan reported 298 total cases with 3 fatalities, the ten most critical countries were: 1) USA; 2) Italy; 3) China; 4) Spain; 5) Germany; 6) France; 7) Iran; 8) the UK; 9) Switzerland and 10) the Netherlands.

The basic reproductive rate ( $R_0$ ) of the Covid-19 is considered similar or higher than the SARS-Cov and pandemic influenza (PETERSEN et al, 2020). Due to fast transmission (Figure 3), in one year, since the “first” official case, at 23:59 (GMT) on December 31, 2020, the world officially lost 1.824 million lives, with 1st) USA (354,215), 2<sup>nd</sup>) Brazil (194,976), 3<sup>rd</sup>) India (149,018), 4<sup>th</sup>) Mexico (124,897), 5<sup>th</sup>) Italy (74,159), 6<sup>th</sup>) UK (73,512), 7<sup>th</sup>) France (64,632), 8<sup>th</sup>) Russia (57,019), 9<sup>th</sup>) Iran (55,223), and 10<sup>th</sup>) Spain (50,837) among the ten top critical countries, leading the total number of fatal cases, while Taiwan reported only 7 deaths, located in the 181 position among 220 countries (WORLDOMETERS, 2020).

All	Europe	North America	Asia	South America	Africa	Oceania								
#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population	
	World	83,793,959	+738,738	1,824,915	+13,552	59,320,807	22,648,237	106,365	10,750	234.1				
1	<a href="#">USA</a>	20,445,654	+228,413	354,215	+3,438	12,125,806	7,965,633	29,214	61,588	1,067	253,542,640	763,737	331,976,250	
2	<a href="#">Brazil</a>	7,675,973	+56,003	194,976	+1,036	6,747,065	733,932	8,318	35,984	914	28,600,000	134,073	213,316,626	
3	<a href="#">India</a>	10,286,329	+19,046	149,018	+244	9,881,786	255,525	8,944	7,417	107	172,049,274	124,063	1,386,789,921	
4	<a href="#">Mexico</a>	1,413,935	+12,406	124,897	+1,052	1,066,771	222,267	3,913	10,909	964	3,596,935	27,752	129,609,888	
5	<a href="#">Italy</a>	2,107,165	+23,476	74,159	+555	1,463,111	569,895	2,555	34,877	1,227	26,598,607	440,250	60,417,000	
6	<a href="#">UK</a>	2,488,780	+55,892	73,512	+964	N/A	N/A	1,847	36,565	1,080	54,892,984	806,479	68,064,964	
7	<a href="#">France</a>	2,620,425	+19,927	64,632	+251	194,221	2,361,572	2,634	40,101	989	35,025,374	535,998	65,346,149	
8	<a href="#">Russia</a>	3,159,297	+27,747	57,019	+593	2,554,340	547,938	2,300	21,644	391	90,648,889	621,028	145,965,971	
9	<a href="#">Iran</a>	1,225,143	+6,391	55,223	+128	988,833	181,087	5,039	14,494	653	7,566,946	89,519	84,529,401	
10	<a href="#">Spain</a>	1,936,718	+15,603	50,837	+148	N/A	N/A	2,018	41,415	1,087	27,016,086	577,712	46,763,897	

Fig. 3: The ten most critical countries in terms of total deaths cases of Covid-19 on December 31, 2020

Source: Worldometers (2020)

## 6. WHO and Taiwan Strategic Preparedness and Response Plan for Pandemic

For WHO (2018 p.2), a pandemic is a worldwide spread of a new disease, so the planning and preparation are critical to helping to mitigate the risk and impact of a pandemic, and to manage the response and recovery.

According to The Global Health Security Index 2019 report, no country is fully prepared for epidemics or pandemics, and every nation has important gaps to address. One recommendation of the report is that national health authorities should develop epidemic and pandemic specific preparedness and response strategies as part of routine disaster and broader national security planning efforts (NTI, JHU, and EIU, 2019 p. 15)



Lessons learned from SARs CoV 2002/2003 and 2009 influenza (H1N1) contributed to the WHO development of models to help countries to prepare and respond to epidemic and/or pandemic. For example, they published a Checklist for influenza pandemic preparedness planning (WHO, 2005), a Pandemic Influenza Risk Management (WHO, 2017), a Checklist for pandemic influenza risk and impact management 2018 (WHO, 2018), which replaced the WHO (2005) version and can be used with WHO (2017). Also, since 12 February 2020, they provided a draft with guidance for the Covid-19 Strategic Preparedness and Response Plan (WHO, 2020b).

According to Chung (2017), Taiwan was devastated by the SARS2003 outbreak, many front line healthcare workers became infected while taking care of patients. Also, several hospitals and schools were closed with more than 151,000 people quarantined at home. At that time, Taiwan did not receive timely information on the SARS virus and depend on the expertise experiences shared about the USA CDC guidelines on how to control the outbreak.

Since that time, Taiwan public health and experts started to participate in WHO SARS conferences and developed several strategic measures to improve the preparedness and response processes such as:

1) Established the National Health Command Center (NHCC) in 2004 (WANG, 2020) to address public health emergency and provide disaster information for decision-makers (Figure 4);

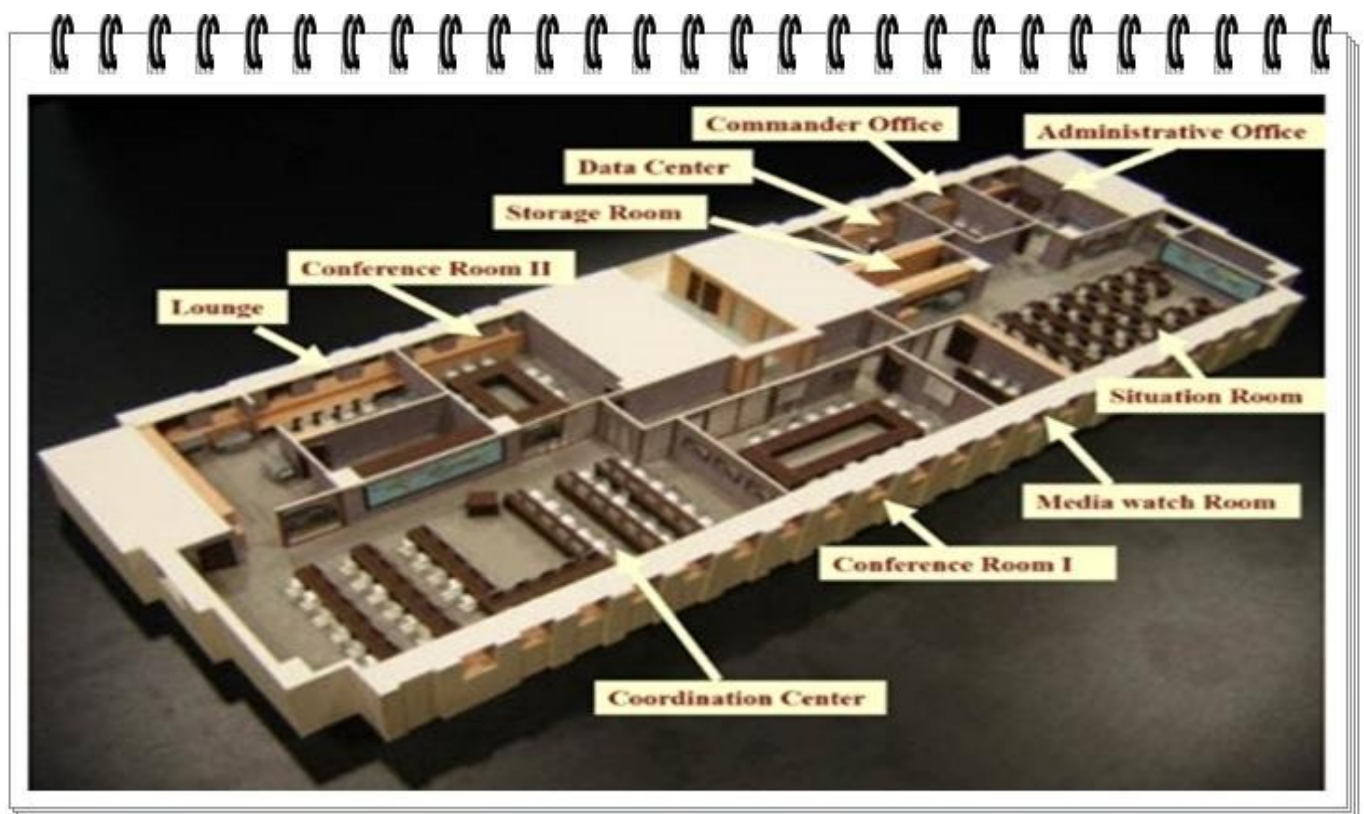


Figure 4: Layout of NHCC

Source: TCDC (2018)

2) Enacted and amended act/laws/regulations to empower government, experts and related managers during epidemic/pandemic; 3) Developed and approved the National Influenza Pandemic Preparedness

and Response Plan in 2005; 4) Developed the Influenza Pandemic Strategic Plan, which first, second and third edition (TCDC, 2012) were approved respectively by Executive Yuan on January 2, 2007, February 20, 2008, and May 18, 2010; 5) Created a pre-pandemic stockpile of A/H5N1 vaccine for human use in 2007; 6) Establish a three-tier preparedness plan that includes efforts by the National and Local Governments, and Healthcare Institutions to maintain a 30-day stockpile of personal protective equipment; 7) in 2020, developed the Preparedness and Contingency Planning in Response to Covid-19 Epidemic.

For example, regarding the establishment of the NHCC in 2004, it is a unified central command system that includes the Central Epidemic Command Center (CECC), the Biological Pathogen Disaster Command Center (BPDCC), the Counter-Bioterrorism Command Center (CBCC) and the Central Medical Emergency Operations Center (CMEOC). It can accommodate 100 persons (Figure 4) at the same time working there (WANG, 2020; TCDC, 2018).

Concerning the act/laws/regulations, in liberal democracies, the law is central to pandemic response and Taiwan has developed a framework for detecting and reporting epidemics following International Health Regulations (LEE, 2020b). According to Taiwan President Tsai, any contingencies against the pandemic can be addressed by existing legislation. Besides, the legal framework is considered part of Taiwan's success in fighting the Covid19 pandemic (CHANG, 2020).

Several acts/laws/regulations have been used (partially or totally) over time to better prepare and respond to epidemic or pandemic in Taiwan, with three enacted during the Covid-19 pandemic. Chart 2 shows nine cases that are playing important role during this pandemic, most (5) was enacted before SARs CoV 2002/2003 and 4 enacted after that. Also it is important to note that most amendments in the norms happened after SARs CoV 2002/2003.

Acts/Law/Reg.	Dates & amendments	Main parts and some applications
1) Regulations Governing Quarantine at Ports	1930-06-28 13 amendments (6 were made since SARs 2003)  2017-10-17 (last)	42 articles to regulate governance quarantine at ports: general principles, quarantine at conveyances, quarantine of personal, ship sanitation, sanitation of ports, quarantine of domestic ports, supplementary provisions. For example, this regulation was used to quarantine and monitor travelers infected or suspected to carry a communicable virus during the pandemic. Site: <a href="http://bit.ly/38IOz9t">http://bit.ly/38IOz9t</a>
2) Communication Disease Control Act (CDCA)	1944-12-05 15 amendments (11 were made since SARs 2003)  2019-06-19 (last)	77 articles to arrest the occurrence, infection, and spread of communicable diseases: general principles, disease control systems, prevention of communicable diseases, disease control measures, quarantine measures, penal provisions, supplementary provisions. Site: <a href="http://bit.ly/3aDEBbW">http://bit.ly/3aDEBbW</a>

Continuation of Chart 2

Acts/Law/Reg.	Dates & amendments	Main parts and some applications
3) Pharmaceutical Affairs Act	<p>1970-08-17</p> <p>18 amendments (13 were made since SARs 2003)</p> <p>2018-01-31 (last)</p>	<p>More than 100 articles for the administration of pharmaceutical affairs: general provisions, management of pharmaceutical firms, management of pharmacies and dispensation of drugs, registration and market approval of drugs, patent linkage of drugs, sales and manufacture of medicament, management of controlled drugs and strongly poisonous drugs, management of advertisements on medical, investigation and interdiction, penal provisions, supplementary provisions.</p> <p>For example, by using Article 48-2 the Taiwan Food and Drug Administration approved, subject to certain conditions, the importation with permission of anti-viral drug Remdesivir for the of patients with severe Covid19 infection.</p> <p>Site: <a href="http://bit.ly/3rs77Dm">http://bit.ly/3rs77Dm</a></p>
4) Foreign Trade Act	<p>1993-02-05</p> <p>10 amendments (8 were made since SARs 2003)</p> <p>2019-12-25 (last)</p>	<p>More than 37 articles to expand foreign trade and maintaining a sound trade order to enhance the economic benefits of this country in the spirit of liberalization and internationalization and on the principles of fairness and reciprocity.</p> <p>For example, Article 11 was used on 31 January 2020 to ban all export of medical masks.</p> <p>Site: <a href="http://bit.ly/2MamRKX">http://bit.ly/2MamRKX</a></p>
5) Personal Data Protection Act	<p>1995-08-11</p> <p>2 amendments, all made since SARS 2003</p> <p>2015-12-30 (last)</p>	<p>56 articles to regulate the collection, processing, and use of personal data to prevent harm on personality rights, and to facilitate the proper use of personal data: general provisions, data collection, processing and use by a government agency, data collection, processing and use by a non-government agency, damage and class action, penalties, supplementary provisions.</p> <p>For example, this law is used when Apps or other technologies are used during Border Control or Quarantine measures.</p> <p>Site: <a href="http://bit.ly/3aT8ncO">http://bit.ly/3aT8ncO</a></p>

Continuation of Chart 2

6) Enforcement Regulations Governing the CECC	2004-12-20 1 amendment 2008-01-28 (last)	15 articles to set regulations about the governance of the CECC. It allows the Ministry MOHW, with the Executive Yuan approval, to establish the CECC to formulate policies, integrate resources, and co-ordinate responses across different government ministries and agencies. Site: <a href="http://bit.ly/3pqc11U">http://bit.ly/3pqc11U</a>
7) Medical Devices Act	2020-01-15 No amendments	85 articles to ensure the safety, effectiveness, and quality of medical devices to be used by citizens, to promote the health of citizens, and to improve management of medical devices. This new act separates the regulation of medical devices from pharmaceutical products for the first time. It standardizes the registration of devices, tightens the classification system, and permits rapid approvals for innovative products. Site: <a href="http://bit.ly/34VfSwb">http://bit.ly/34VfSwb</a>
8) Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens (SAPRRM)	2020-02-25 1 amendment 2020-04-21 (last)	19 articles to effectively prevent and control severe pneumonia with novel pathogens (Covid-19), protect the health of the people and mitigate the impact of the disease on the domestic economy and society. In 2020, a total of NT\$ 210 billion was approved as Covid-19 Special Budget to be used by Taiwan Agencies support several Programs, Project and Actions developed under this law. Site: <a href="http://bit.ly/3rnvGS1">http://bit.ly/3rnvGS1</a>
9) Regulations Governing the Operational Procedures and Compensation for Expropriation of Manufacturing Equipment and Raw Material of Disease Prevention Supplies for Severe Pneumonia with Novel Pathogens	2020-03-10 No amendment	17 articles developed to help government agencies to deal to the shortage of medical supplies such as face masks.  These Regulations respect the provisions of Paragraph 2, Article 5 of the SAPRRM described above.  Site: <a href="http://bit.ly/3hsBjK1">http://bit.ly/3hsBjK1</a>

Chart 2: Main Act, Law or Regulation used in Taiwan during epidemic/pandemic

Sources: Taiwan Ministry of Justice

Concerning the Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b), it has only 12 pages with a legal basis, aims, activation protocol for preparedness and contingency planning, strategies for contingency planning, and assignment of responsibilities.

When this Planning is compared with four WHO models (WHO 2005; WHO 2017; WHO 2018; WHO 2020) it is possible to identify (Chart 3) that Taiwan differently emphasizes the following components: Activation Protocol for Preparedness and Contingency Planning, Implementation of Border Quarantine, Inventory checking of medical supplies and equipment, Tightening border quarantine, Perfecting the Health System, Enhance testing and diagnostic capabilities, Community based epidemic prevention, and Developing International collaboration.

Taiwan PCPRCovid-19 Epidemic's main components (TCDC, 2020b)	Checklist WHO (2005)	PI Risk Management WHO(2017)	Checklist WHO (2018)	Covid19 SPRP WHO(2020)
12 pages	39 pages	62 pages	44 pages	33 pages
II. Legal Basis	Yes	Yes	Yes	Yes
III. Aim	Yes	Yes	Yes	Yes
<b>IV. Activation Protocol for Preparedness and Contingency Planning</b>	<b>No</b>	<b>No</b>	<b>No</b>	Yes
V. Preparedness Planning in Taiwan: Strategies				
A. Continuous epidemiological surveillance and R.M.	Yes	Yes	Yes	Yes
B. Implementation of border quarantine	<b>No</b>	<b>No</b>	<b>No</b>	Yes
C. Inventory checking of medical supplies and equipment	<b>No</b>	<b>No</b>	<b>No</b>	Yes
D. Strengthening risk communication	Yes	Yes	Yes	Yes
E. Enhance testing and diagnostic capabilities	No	Yes	Yes	Yes
VI. Contingency Planning in Taiwan: Strategies				
A. Continuous epidemiological surveillance and R.M.	Yes	Yes	Yes	Yes
<b>B. Tightening border quarantine</b>	<b>No</b>	<b>No</b>	<b>No</b>	Yes
<b>C. Perfecting the Health System</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>
D. Allocation and management of medical supplies and equipment	No	Yes	Yes	Yes
<b>E. Enhance testing and diagnostic capabilities</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>
F. Constant risk communication	Yes	Yes	Yes	Yes
<b>G. Community based epidemic prevention</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>No</b>
H. Epidemiological investigation	Yes	Yes	Yes	Yes
<b>I. Developing International collaboration</b>	<b>No</b>	<b>No</b>	<b>No</b>	Yes
V. Assignment of Responsibilities	Yes	Yes	Yes	Yes

Chart 3: Taiwan PCPRCovid-19 Epidemic's main components versus WHO models

Sources: WHO (2005, 2017, 2018 and 2020)



## 7. Fatal Cases Indicators and Fatality Total Index (FTI)

Not only good data is relevant (BALSARI, BUCKEE, AND KHANNA, 2020), but also the indicators. Several organizations are developing indicators and collecting data related to fatal cases of Covid-19, such as a) case fatality rate (CFR); b) deaths per capita; c) tests per confirmed deaths; d) a total number of death cases by age; e) a total number of fatal cases by a total number of cases; f) the total number of fatal cases by 100 confirmed cases; g) the total number of fatal cases by a total number of recovered cases; h) the total number of fatal cases by 100,000 population.

However, one limitation of these indicators is that they don't take into consideration the percentage of symptomatic cases reported (PSCR), and the % of symptomatic cases that have been missed by the surveillance system over time, reason by which Silva (2020b p. 563) proposed a new Indicator called Fatality Total Index (FTI), as shown in formula (1):

$$(1) \text{ FTI} = [ (\text{TFC} / \text{XMPSCRnd}) / 1\text{MP} / \text{ND} ]$$

TFC = Total Fatal Cases

XMPSCRnd = The Average of the Median of PSCR related to the ND

1MP = one million of the population

ND = Nth day facing the Covid-19 since the first official case reported by National Government

The TFC is collected from the worldometer site <<https://bit.ly/3dpMERI>> and the population of each country was collected from the United Nations Population Fund (2019), which shows the population of each country and other indicators for 2020.

Table 1: Example of Italy Median Percentage of Symptomatic Cases Reported (PSCR)

DATE	COUNTRY	MEDIAN	LOWER 95 CRI	UPPER 95 CRI
2020-02-13	Italy	0,07619631716921	0,063166815916984	0,089605585590268
2020-02-14	Italy	0,073230329695997	0,060871204520831	0,085925137289357
2020-02-15	Italy	0,070426159884898	0,058704300698846	0,082477598273003
2020-02-16	Italy	0,067791120707594	0,056690925216948	0,079220002324427
2020-02-17	Italy	0,065331127805584	0,054809794089387	0,076155309480703
2020-02-18	Italy	0,063050778573396	0,053083941954428	0,073311384509538
2020-02-19	Italy	0,060953458924782	0,051497931974269	0,070683925618618
2020-02-20	Italy	0,059041471795511	0,050068430758611	0,068251532028991
2020-02-21	Italy	0,057316180922205	0,04877654590104	0,066061441790509
2020-02-22	Italy	0,055778163240681	0,047624316273539	0,064117091801045
2020-02-23	Italy	0,054427363337249	0,046618204644091	0,062311604226192
2020-02-24	Italy	0,053263243713593	0,045755917730674	0,060810641060784
2020-02-25	Italy	0,052284925131905	0,045045547058412	0,059549070440637
2020-02-26	Italy	0,051491311932404	0,044480390532982	0,058522931161805
2020-02-27	Italy	0,050881197906485	0,044050973322455	0,057717438663351
2020-02-28	Italy	0,050453349023576	0,043769618789369	0,057131649041495
2020-02-29	Italy	0,050206560022131	0,043624358455376	0,056775873280491

Source: Golding, N. et al. (2020)

The XMPSCRnd was calculated from the data (Table 1) provided by Golding, N. et al. (2020). Since each country was evaluated for 10 months (ND=305), it was used the median of PSCR related to the nth day identified for each country, taking into consideration the delay of 13 days, by using the under-reporting estimates available in the.csv file on the CMMI site <<https://bit.ly/30N6qtj>>.



## 8. Methodology

The research is applied, descriptive, with a quantitative and qualitative approach, based on bibliographic and documentary research, involving the study of official sites, articles, technical reports, guidelines, standards, manuals, collected from the internet.

To reach the specific objectives, the collection and data analysis were made in five phases:

Phase 1) to present WHO models and Taiwan Strategic Preparedness and Response Plan for Pandemic

Since the WHO is the world guardian of Health, it was searched and shortly describe four examples of models developed by the organization over time to help countries to prevent and better respond to epidemic/pandemic. Besides, Taiwan's Strategic Preparedness and Response Plan for Pandemic was introduced and compared with WHO models.

Phase 2) to present Taiwan Models for combating the Covid-19

Several Authors (HAN ET AL, 2020; HONG, 2020; SILVA, 2020b; SUMMERS ET AL, 2020; YEH, M.-J. AND CHENG, Y., 2020; WANG, C.J., NG, C.Y. AND BROOK, R.H., 2020) consider Taiwan as a successful country during Covid-19 pandemic, but few explored in detail about the Models adopted by National Government and partners, as well as the country performance over time.

The models were investigated by searching scientific articles, technical reports, and also official sites from Taiwan. As a result, the best sources are official sites created in Taiwan to share their experience with the world, one is from Taiwan External Trade Development Council (TAITRA, 2020) and the other is from the Taiwan Ministry of Health and Welfare (MOHW, 2020b).

From the information of those two sites, it was possible to systematize and explain the models, which part of their components are also described by Hong (2020), Summers et al (2020), Yeh, M.-J. and Cheng, Y. (2020), Wang, C.J., Ng, C.Y. and Brook, R.H. (2020).

Phase 3) to investigate Taiwan main leaders background

The investigation focus on the main background of Taiwan Leaders that occupied the Presidency, Vice Presidency, and the MOHW in the last 20 years. The Taiwan Government sites are the main source and the search is related to Education (Graduation, Master, and Doctor) and main posts occupied by the leaders from 2000 until 2020.

Phase 4) to compare Taiwan performance against 43 semifinalist countries

Silva (2020b) developed a holistic methodology with fifteen phases divided by rankings to identify the best 20 benchmark countries that are saving lives against Covid-19.

It used 13 international raking (5 related to Health, one related to Medical Innovation, 2 related to Sustainability, 2 related to Image, and 3 related to Competitiveness) to identify those countries that were among the 50 top winners in each ranking. As a result, a total of 108 countries were considered as well-evaluated by applying the average, standard deviation, coefficient variation, and median on each nation score, generating a list of 44 semifinalist countries that were present in at least seven of the investigated rankings. And finally, to identify the 20 benchmark countries, for each of the 44 semi-finalists, the Fatality Total Index (FTI180) was used to estimate the real number of fatal cases by the one million population during 180 days facing the pandemic.

Taiwan was in second place and the reason to make a new comparative analysis against the 43 semifinalists, is to check the performance evolution of this country over time when 305 days (10 months) are considered.

The data were collected daily from the worldometers site, from December 31, 2019, until December 31, 2020. For each country, it was identified the official date where occurred the first case of Covid-19, and also the date when completed 305 days facing the pandemic (DTFC305). After that, Formula (1) was applied for each country, and they are ranked in ascending order by using the FTI305 Indicator.

Table 2 (section 9.3) shows the fields: Rank, Countries, Continent, SARS2003\_TFC (Total Fatal Case of SARS in 2003)/TC(Total Case), START (Date of first Covid-19 reported), P2020 (Population per Million), PD20 (Population Density 2020), AGE>65 (Percentage of people over 65 years old in 2020), HBED/1K (Number of Hospital Beds per 1000 people), TFC305 (Total of Fatal Cases in 305 days), TFC3051M (Total of Fatal Cases in 305 days per 1M people), FTI305 (Fatality Total Index in the 305th day taking into consideration the delay of 13 days).

Phase 5) identify the best management practices adopted in Taiwan, taking into consideration cultural practices, main policy measures, programs, projects, strategies, and innovative solutions.

In June/20, it was developed an on-line Survey <<https://ufam.typeform.com/to/UL7R8M>> containing nine questions related to:

Q1) the country of the respondent, with 15 benchmark countries (including Taiwan) listed, selected by the author in that time taking into consideration the FTI100;

Q2) eleven cultural practices that the respondent believes were decisive for the low rate of death, with one option for those that don't believe culture practice were decisive;

Q3) how much (0-10) the respondent trust in official statistics released by the National Government about the number of deaths cases by Covid-19;

Q4) what are the main policy measures (18 options, multiple choice) adopted by the National Government that saved lives against the Covid-19;

Q5) an opened question to inform (if know), the name of the most innovative product or service that are protecting people against Covid-19. This question aims to identify some tips for the researcher intensify the search on the internet;

Q6) the age;

Q7) if the respondent is native or not;

Q8) an open question to identify how long the respondent is living in the country;

Q9) an open question for suggestions or to inform e-mail, just in case the respondent is interested to receive the scientific article.

Typeform <<https://www.typeform.com/>> platform was used freely. Other software was used such as Edraw Max editor, Libre Office package, Videorobot, Viddyoze, Piktochart, and Photoscape.

The main aim of this questionnaire is to identify the perceptions of people living in Taiwan, the respondent must have more than 17 years old and living in the country for at least four months.

The pilot test was from June 21st to July 21th, after that, some improvements were to make it easier to answer. The survey continues from the beginning of August until the 9th of November, 2020. Because

he difficulty to collect data, it is worth noting that from 26/October to 09/November, another questionnaire was created in Traditional Chinese to run together with the English survey.

To invite people, it was paid the Facebook service called “Post a post”, invitations with the link of the questionnaire was written in English and later in Traditional Chinese, and sent to the audience of Taiwan.

Due to Covid-19 and cost limitations, it was tried to carry out sampling for convenience, where the researcher depends on the availability of the respondent to contribute in a volunteer way for the survey. As a result, a confidence interval or margin of error was not adopted, but it was hoped to get at least 100 correct answers.

Finally, from June until ending December 2020, parallel to the online questionnaire, several searches on articles, sites of government, universities, journals, startups, associations, and companies of Taiwan were realized to identify the innovative products and services adopted to protect and save lives against the Covid-19.

## **9. Results**

### ***9.1 Taiwan Models to prevent and respond to Covid-19 Pandemic***

To share Taiwan's successful experience with the international community, two models were identified, as explained in the next sections.

#### **9.1.1) Taiwan Model according to TAITRA (2020)**

Taiwan External Trade Development Council (TAITRA) was founded in 1970, it is a nonprofit trade organization, supported by the industry and government, to assist the enterprise to expand its global reach. It has a team with 1300 specialists, 5 local offices in Taiwan, and 63 branches around the world.

Since 15th June 2020, TAITRA and partners developed, launched, and are updating the Taiwan Global Anti-Covid-19 Pavilion, a website to share information on Taiwan:

a) Epidemic Prevention in Public Health, Smart Health, Disease Control; b) Anti-Epidemic Products Providers; c) Medical Services; d) Business Map; e) Expert Column and Online Seminars; f) Product Launch; g) News with latest technology information; h) and Taiwan Model for Combating the Covid-19.

According to TAITRA (2020), Taiwan Model is composed of six components (Figure 5):

Component 1) Advance Preparations: since the detection of suspected cases identified in China on 31 December 2019, several actions were deployed as explained in Chart 1 and according to Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b);

Component 2) National Health Insurance (NHI): it was introduced in March 1995, it is a single-payer mandatory for all Taiwan citizens (coverage rate = 99%) except for prisoners and people who have moved out of the country (WU et al, 2010).

It has comprehensive medical coverage including for those suffering from Covid-19. The accessibility of Health Care is provided by 93% of a medical institution (100%=hospital; 92.6%=primary clinics; 79.3%=pharmacies).

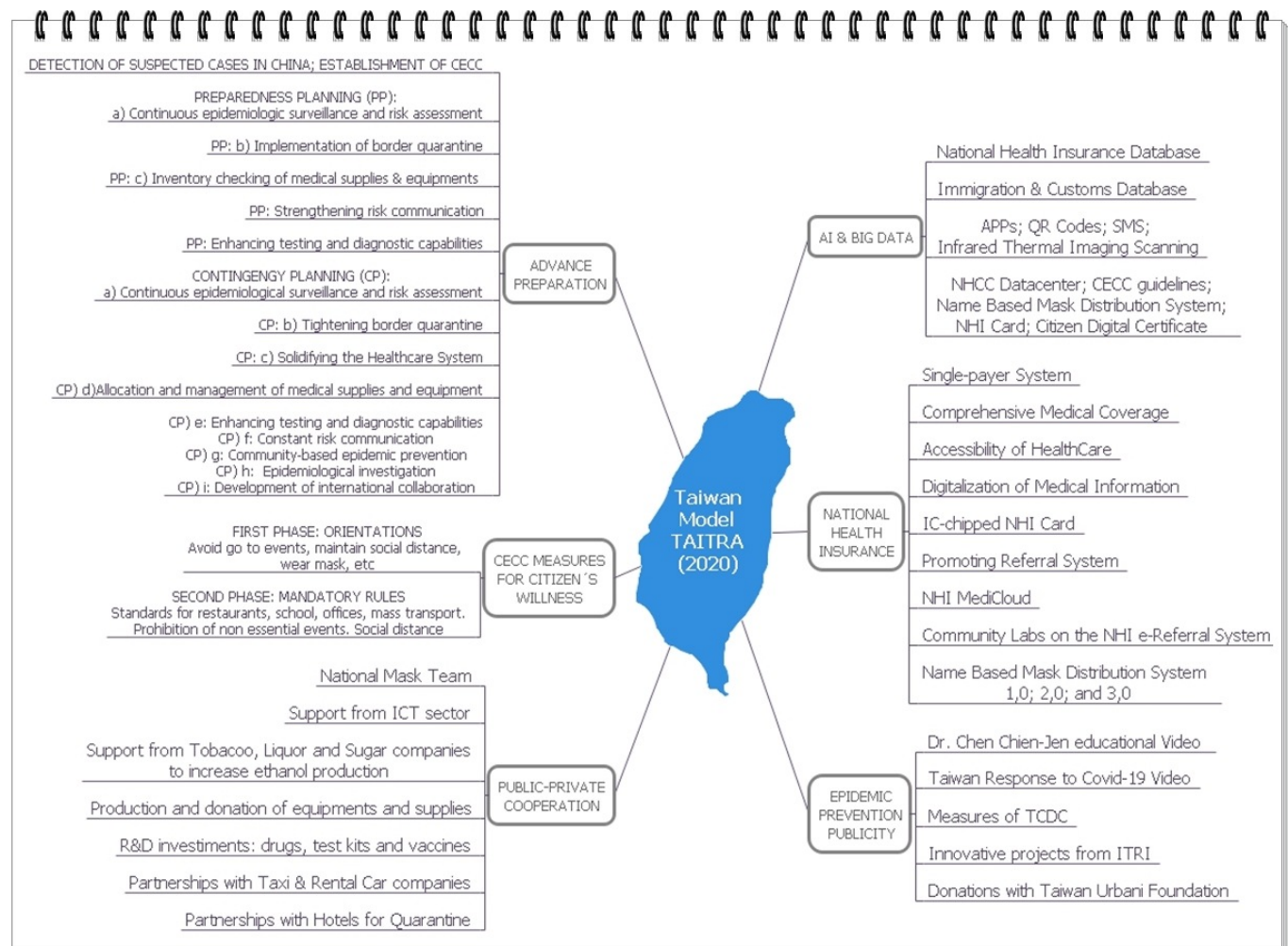


Figure 5: Taiwan Model for Combating the Covid-19

Sources: TAITRA (2020)

The digitalization of medical information contributed to improve the services and make the Taiwan health insurance administrative cost among the lowest in the world. Several smart functions are accessed by IC-chipped NHI Card (Figure 6), which permits to doctor to quickly obtain medical records (last six medical visits, drug prescriptions, examination results, identify patient's information) to prescribe appropriate treatment. Also, this card allows suspected cases to be monitored and detected in real-time.

Since 2016, the Referral System was established into NHI to encourage patients with minor illness to search for care at local clinics, to reduce waste, and overcrowd hospitals or medical centers (CHENG, 2020).

The NHI Administration also established the NHI-MediCloud System (Figure 7) which permitted from 2014 to 2017 the reduction of days repeated medication, saving US\$ 9.63 million in expenditure for the six main categories of medication. Besides, among the 20 most common examinations and tests, the cloud sharing process saved around US\$ 38.5 million (CHIANG and CHANG, 2019).

The NHI administration set designed community laboratories on the e-Referral System to establish a community screening network for Covid-19 and expand the capacity of medical services, which reduced



suspected cases to rush hospital emergency rooms and lowering the possibility of spreading the coronavirus in hospitals.

Finally, the Name-based Mask Distribution System (1.0 to purchase at pharmacies; 2.0 to realize online purchase; 3.0 to order on Kiosk) was developed and integrated to NHI Card and NHI MediCloud System to permit the authorities to monitor the demand and supply of masks around the country, as well as to guarantee the users to purchase protective masks;



Figures 6 and 7: NHI Card and NHI MediCloud System features

Source: MOHW (2020)

Component 3) Use of Big Data: The NHI Database was leveraged and integrated into the immigration and customs database, which permitted generate real-time alerts during clinical visits bases on patient travel history and clinical symptoms to aid case identification (WANG, 2020). Taiwan also adopted several technologies (Artificial Intelligence, Blockchain, Cloud System, Infrared Thermal Imaging Scanning, QR Code, SMS, UV, etc) to develop products or services to prevent/control the pandemic over time, as shown in Section 9.4.5 and Chart 6 (Appendix).

Component 4) CECC Measures for Citizens Willingness: the main measures were organized in two phases, phase 1 for orientations and phase 2 for mandatory rules.

In phase 1, the CECC oriented people to avoid events no considered essential such as exhibitions, sports, concerts, entertainments. Also, it was recommended to individuals to use a mask properly and keep a distance from others ( $\geq 1.5$  m in indoor;  $\geq 1$  m in outdoor locations environment).

The second phase starts after the rise in the number of imported Covid-19 cases and focused on mandatory rules, the prohibition of nonessential events, social distance standards several organizations such as offices, schools, restaurants, mass transport, supermarkets, etc.

It is important to highlight: a) the use of digital technologies to communicate with people with fast, fair, and fun strategies led by Ministry Audrey Tang; b) platforms to combat fake news such as Contact

Chatbot, Fact-Checking website; Taiwan FactCheck Center; c) the use of regulations to impose heavy penalties to those who violate mask disposal, quarantine, disseminate fake news;

Component 5) Public-Private Cooperation with some example listed bellow:

a) The government provided a budget of NT\$200 million for the National Mask Team to increase production (build 60 face mask production lines), and consolidate domestic enterprises including raw material suppliers and manufacturers to assist in producing supplies for disease prevention. According to Taiwan External Trade Development Council (2020), around 140 people from 29 enterprises, from upstream to downstream, from the machine tool industry and 3 industrial Institutes joined the national team, including managers, factory directors and senior technicians, with an average of 10 years of experience in the industry;

b) Support of ICT Sector to develop several solutions such as Name-based Mask Distribution System, Disease Prevention Mask Control System, Digital Art Fun Coupons, Fight Covid Taiwan Website, Passenger Health Declaration & Home Quarantine Information System;

c) The government coordinate Taiwan Tobacco & Liquor Corporation (TTL), Taiwan Sugar Corporation (TSC) to manufacture hygiene alcohol and distributed them to TTL and TSC retail stores, community pharmacies, cosmetic stores, supermarkets and convenient stores;

d) Tourism Bureau, Ministry of Transportation & Communications is providing financial aid to city and county governments to encourage hotels to participate in the “Epidemic Prevention Quarantine Hotels” program. The program is currently scheduled to run from April 1 to December 31, 2020. Until 14 August 2020, the number of rooms in the epidemic prevention hotel has exceeded 12,000, and the occupancy rate was about 70%;

e) Donations of ambulances, emergency vehicles, protective equipment, infrared thermal imaging cameras;

f) The Academia Sinica, National Health Research Institutes, and Development Center of Biotechnology are conducting R&D on a synthesis of potential treatment drugs, vaccines, and test kits;

g) partnership with taxi and rental car companies to provide services for passengers requiring transportation from airports to home quarantine locations.

Component 6) Epidemic prevention publicity: share videos, guidelines, innovative products and services, donation campaign, etc.

#### 9.1.2) Taiwan Model according to MOHW (2020b)

This model was build from information shared by the Taiwan MOHW (2020b) as part of the Campaign “Taiwan Can Help – Taiwan is Helping”.

MOHW (2020b) model components are organized into 3 main parts as shown in Figure 8 and are strongly focused on the main measures taken by the Taiwan Government to combat the Covid-19.

The main parts are:

Component 1) Key Success Factors:

C1a) SARS 2002/2003 experience showed the need to National Government strength collaboration with the private sector to review the regulations, establish NHCC and review epidemic prevention systems and strategies;



C1b) CECC upgrading its level and organizational structure from level 1 to level 3;

C1c) Information Transparency by:

Employing multiple media channels to timely announce information (daily press conferences, outbreak situation and disease survey results, 1922 Communication Disease Report, Consultation hotline, health education materials, videos, etc) to keep public informed; Providing access to the NHI database for public and private sectors to fight the pandemic.

C1d) Good resource allocation for the: inventory and dispatch of epidemic prevention supplies; face masks production and distribution; increasing the availability of epidemic prevention supplies through multiple channels; monitoring health care and testing capacity and reserve sufficient healthcare personnel; affiliation of Hospital on the front line;

C1e) Timely Border Control to immediately prevent Covid-19 spread from China, monitor the international situation, and adjust travel notices;

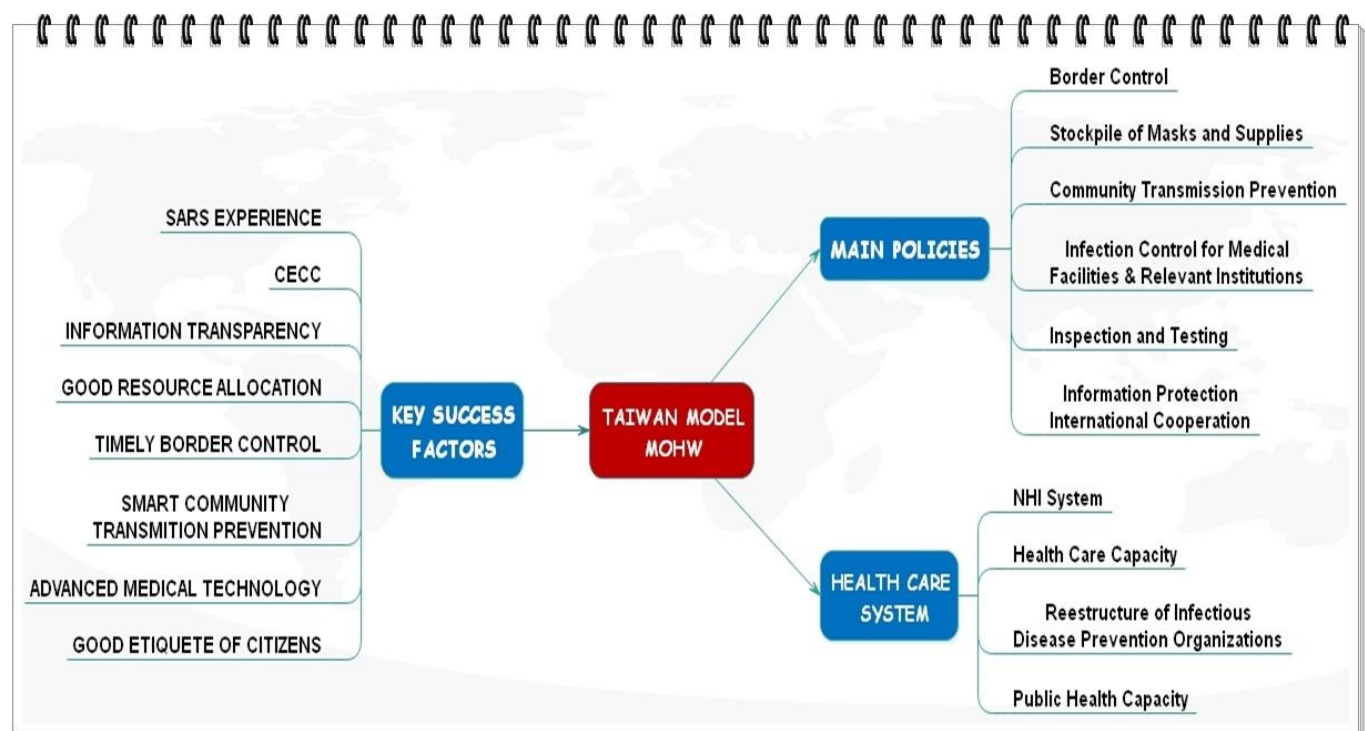


Figure 8: Taiwan Model components for Combating Covid-19

Source: MOHW (2020b)

C1f) Smart Community Transmission Prevention by employing NHI Big Data to help front-line workers to detect cases; adopting technology for isolation and Quarantine; expanding Telehealth care; creating disease prevention network;

C1g) Advanced medical technology by forming a project team to support the development of test kits; establishing laws on green channel and guide major R&D projects; foster the development of test kit; establish technical support platform of Covid-19 to accelerate the development of vaccines, drugs and rapid test kits; collecting resources and cutting-edge technologies for the development of rapid test kits, therapeutics, and vaccine;

C1h) Good Etiquette of Citizen by providing accurate epidemic prevention information to different groups of people; encouraging citizens to develop good personal hygiene habits; teaching elderly how to use their TV for video conferencing and how to use home technology interactive platform, to exercise at home and receive health information.

#### Component 2) Health Care System

C2a) National Health Insurance System as already explained;

C2b) Restructure of Infectious Disease Prevention Organizations such as NHCC and CECC;

C2c) Monitoring Medical Care Capacity and Guarantee Sufficient Medical Care Human Resources

#### Component 3) Public Health Capacity

C3a) Definition of roles of local government health departments and public health centers to prevent disease;

C3b) Development of strategies to keep the outbreak under control such as forming health department and public health center combat teams, local government to establish the care service center to ensure that people in-home quarantine and home isolation are cooperating in disease prevention, the realization of drills, increase people knowledge and abilities to use in the outbreak;

C3c) Provide measures for following up on persons with infection risk;

C3d) Promoting local government home quarantine and home isolation care system Program;

Some products or services developed to prevent/control the pandemic over time are shown in Section 9.4.5 and Chart 6 (Appendix).

## 9.2 Taiwan Main Leaders Background – 2000 to 2020

Some authors (LEE, 2020; LIN et al, 2020; LO and HSIEH, 2020, WANG et al, 2020) argued that part of Taiwan and other Asian Countries' success during the Covid-19 pandemic is because of the experiences learned from SARS2003. However, no research was developed to study the main Taiwan leaders background.

Before study Taiwan performance against Covid-19, it is important to understand the background of the main leaders (President, Vice-President, Minister of MOHW) that managed the country in the last 20 years, a period by which this nation is monitoring, making investment, reforms, and improvements to better prevent and respond to H5N1, H1N1, SARS2003, MERS and Covid-19.

From 2000 until 2020, Taiwan (Table 2):

- a) had 3 presidents, 5 vice presidents, and at least 10 Ministry of Health and Welfare;
- b) in general, 100% has graduation, 61% Master Degree and 50% Doctor degree;
- c) Law dominate the education background of the 3 Presidents, the last two has excellent education with Doctor Degree got in Harvard Law School and London School of Economics and Political Science;
- d) among the 5 vice presidents, 4 (80%) have Master degree (50% related to Law and 50% in Public Health) and one (Dr. Chen) has Doctor degree in Human Genetics and Epidemiology. It is worth to notice that since SARS 2002/2003, Dr. Chen occupied other official posts and is responsible for several reforms to prepare the country for the next outbreaks, epidemic, or pandemic;
- e) among the Ministers of MOHW, at least 50% has Master Course and 60% Doctor Course (Dr. Chen was one of them);

Table 2: Background of the Taiwan President, VP and Minister of MOHW (2000-2020)

Pos	Name - Period	Graduation	Master	Doctor/PhD	Professions
President	Chen Shui 2000-2008	Law NTU	-	-	Legislator, Mayor, President
	Ma Ying-Jeou (2008-2016)	Law NTU	Laws - New York University	Juridical Science Harvard Law School	Deputy, Secretary, Chairman, Minister, Mayor, President
	Tsai Ing-Wen 2016-present	Law NTU	Law - Cornell Univ. Law School	Law -London School of Economics and Political Science	Professor, Chief, Senior Adviser, Legislator, Chairperson, President
Vice President	Lu Hsiu-Lien 2000-2008	Law NTU	Laws – Univ. of Illinois & Harvard	-	Legislator, Magistrate, VP
	Vincent Ciew 2008-2012	Diplomacy NCCU	Law and Diplomacy -NCCU	-	Vice consul, Section Chief, Dir., Chairman, VP
	Wu Den -Yih 2012-2016	Arts NTU	-	-	Journalist, Magistrate, Mayor, VP
President	Chen Chien – 2016-2020	Zoology NTU	Public Health NTU	Human Genetics and Epidemiology - John Hopkins University	Epidemiologist, Professor, Researcher, MoHW, VP.
	Lai Ching 2020 -present	Medical Science NTU	Public Health Harvard University	-	Physician, Legislator, Mayor, VP.
	Lee Ming (2000-2002)	Medicine NTU	-	-	Geneticist, Director, MoHW
Minister of Health	Twu Shiing (2002-2003)	Medicine NTU	Public Health NTU	(?) UCLA	Professor, Secretary, Advisor, Director, Legislator, MoW
	Chen Chien – 2005-2005	Zoology NTU	Public Health NTU	Similar above	Similar above
	Hou Shen 2005-2008	Medicine NTU	?	Clinical Medicine NTU	Physician, Deputy, Director, Vice Sup. and professor, MoHW
Minister of Welfare	Yeh Ching 2008-2009	Medicine NTU	Public Health Harvard SPH	-	MoHW, deputy
	Yaung Chih 2009-2011	Health Education NTU	Public Health NTU	Population Planing Univ. of Michigan	Professor, Chairmain, Director, MoHW,
	Chiu Wen 2011-2014	Medicine CSM University	?	Epidemiology Univ. of Pittsburgh	Professor, Dean, Superintendent, MoHW
Minister of Education	Chiang Been 2014-2016	Biology Fu-Jen C.U	Food Science Univ. of Illinois	Food Science Univ. of Illinois	Professor, Director, Dean, MoHW
	Lin Tzou 2016-2017	Medicine TM College	-	-	Professor, Superintendent, MoHW
	Chen Shih 2017 - present	Dentistry TM College	-	-	Advisor, Director, Deputy, MoHW
Total		18	11	9	-

Source: Government of Republic of China - Taiwan <<http://bit.ly/37IBjSH> and <https://bit.ly/3pfccwI> >

f) most leaders have a good education and experience background, with Dr. Tsai (President) and Dr. Chen (last Vice President) being globally recognized as an example of leaders able to inspire, prepare and unify the country against the Covid-19 pandemic.

In short, the law and medicine related background of these leaders may have contributed to the development of a society with a strong respect for legal practices, science, and for medical professionals.

### ***9.3 Taiwan Performance against 43 semifinalist countries***

Taiwan is close to China, 180 Km from Taiwan Strait and 943 Km from Taipei to Wuhan, with thousand of people traveling between these countries, especially during the Lunar New Year Holiday on January 25, 2020, reason by which, it was a source of high concern for the Taiwan National Government.

Among the 44 semifinalist countries identified by Silva (2020b), the first countries that reported the cases of Covid-19 were: 1st) China (31th/Dec/19); 2nd) Thailand (13th/Jan); 3rd) Japan (16th/Jan); 4th) SK (20th/Jan); 5th and 6th) Taiwan and USA (21th/Jan); 7th and 8th) Vietnam and Singapore (23th/Jan); 9th) France (24th/Jan), 10th and 11th) Malaysia and Australia (25th/Jan/2020).

During nine months facing SARS2002/2003, Taiwan reported 37 deaths cases (10.7%) from a total of 346 cases (WHO, 2003). However, in terms of Covid-19, during 10 months (305 days), it reported 7 (9,4%) fatal cases from 742 total cases. The number of 7 fatal cases in Taiwan during ten months facing the pandemic is the lowest when compared with the similar period of the 43 countries. The five best are Taiwan (7), New Zealand (25), Singapore (28), Iceland (28), and Vietnam (35). On the other hand, the USA (261772), UK (59051), Italy (56361), France (50237), and Spain (45511) are the most critical countries.

Tables 3 and 4 show the basic profile and performance (FTI305 in ascending order) of the 44 countries, taking into consideration the real estimated number of Covid-19 fatal cases by one million population during the first 10 months facing the pandemic.

The main results are:

a) Taiwan is the best country, with FTI305 equal to 0.0019, followed by Vietnam (0.0035), Thailand (0.0036), China (0.0131), Singapore (0.0168), New Zealand (0.0295), Malaysia (0.0385), SK (0.0431), Japan (0.0862) and HK (0.1180), all considered the top ten benchmark countries, 90% from Asia and 10% from Oceania. Here is important to note that except Japan (no case), South Korea (0), and New Zealand (0), the seven other countries reported at least two fatal cases of SARS2003, with the highest cases reported in China (349), HK (299 fatal cases), Taiwan (37), and Singapore (33), which indicates that those countries have learned from the past lessons and are more prepared to respond for the pandemic.

b) On the other hand (Table 4), Spain (FT305=29.0983), Hungary (13.6797), Italy (12.1514), Slovenia (11.5379), UK (11.1674), Belgium (9.3295), France (5.5491), Czech (5.2733), Sweden (5.1175), and USA (5.1172) were the ten most critical countries with the highest number of FTI305. In this group, most countries (90%) is from Europe and only the USA (10%) is from North America. Besides, among these countries, 40% (Czech, Belgium, Slovenia, and Hungary) did not report any case of SARS2003, and only France reported one fatal case of that pandemic, which indicates that most countries did not have experience in dealing with a high number of SARS2003 disease cases.



Table 3: twenty best countries profile &amp; performance in ascending order of FTI305

R	COUNTRIES	CONTINENT	SARS2003 ID/TC	START	P2020 (Mil)	PD20	AGE >65(20)	HBE D/100K	DTFC305	TFC305	FTI305
1	TAIWAN	Asia	37 / 346 = 10.7%	21/01/20	23,82	673,00	14,00	6,98	21/11/20	7	0,0019
2	VIE TNAM	Asia	5 / 63 = 7,93%	23/01/20	97,34	308,13	7,90	2,60	23/11/20	35	0,0035
3	THAILAND	Asia	2 / 9 = 22,2%	13/01/20	69,80	135,13	13,00	2,10	13/11/20	60	0,0036
4	CHINA	Asia	349 / 5327 = 6,55%	31/12/19	1439,32	147,67	12,00	4,34	31/10/20	4634	0,0131
5	SINGAPORE	Asia	33 / 238 = 13,87%	23/01/20	5,86	7915,73	13,40	2,40	23/11/20	28	0,0168
6	NZ	Oceania	0 / 1 = 0%	28/02/20	4,82	18,21	16,40	2,61	29/12/20	25	0,0295
7	MALAYSIA	Asia	2 / 5 = 40%	25/01/20	32,38	96,25	7,20	1,90	25/11/20	345	0,0385
8	SK	Asia	0 / 3 = 0%	20/01/20	51,28	527,97	15,80	12,27	20/11/20	501	0,0431
9	JAPAN	Asia	NO CASE	16/01/20	126,49	347,78	28,40	13,05	16/11/20	1885	0,0862
10	HK	Asia	299 / 1755 = 17,04%	23/02/20	7,50	7039,71	18,20	-	24/12/20	135	0,1180
11	AUSTRALIA	Oceania	0 / 6 = 0%	25/01/20	25,50	3,20	16,20	3,84	25/11/20	907	0,1581
12	UAE	Asia	NO CASE	27/01/20	9,90	112,44	1,30	1,20	27/11/20	567	0,1993
13	ICELAND	Europe	NO CASE	28/02/20	0,34	3,40	15,60	2,91	29/12/20	28	0,3090
14	QATAR	Asia	NO CASE	27/02/20	2,89	227,32	1,70	1,20	28/12/20	244	0,3214
15	FINLAND	Europe	NO CASE	29/01/20	5,54	18,14	22,60	3,28	29/11/20	393	0,3349
16	NORWAY	Europe	NO CASE	26/02/20	5,42	14,46	17,50	3,60	27/12/20	421	0,3457
17	CYPRUS	Asia	NO CASE	09/03/20	1,21	127,66	14,40	3,40	08/01/21	141	0,4796
18	DENMARK	Europe	NO CASE	27/02/20	5,79	136,52	20,20	2,50	28/12/20	1204	0,9637
19	ESTONIA	Europe	NO CASE	27/02/20	1,33	31,03	20,40	4,69	28/12/20	213	0,9970
20	GERMANY	Europe	0 / 9 = 0%	27/01/20	83,80	237,01	21,70	8,00	27/11/20	16172	1,0026

Source: Author (2020)

Table 4: 24 countries profile &amp; performance in ascending order of FTI305 (Continuation of Table 3)

R	COUNTRIES	CONTINENT	SARS2003 ID/TC	START	P2020 (Mil)	PD20	AGE >65(20)	HBE D/100K	DTFC305	TFC305	FTI305
21	ISRAEL	Asia	NO CASE	21/02/20	8,67	402,61	12,40	2,99	22/12/20	3136	1,4307
22	CANADA	North America	43 / 251 = 17,13%	27/01/20	37,74	4,04	18,10	2,50	27/11/20	11894	2,2037
23	LATVIA	Europe	NO CASE	02/03/20	1,89	31,21	20,70	5,57	01/01/21	644	2,2646
24	GREECE	Europe	NO CASE	26/02/20	10,43	83,48	22,30	4,21	27/12/20	4606	3,2335
25	AUSTRIA	Europe	NO CASE	25/02/20	9,00	106,75	19,20	7,37	26/12/20	5843	3,2415
26	MALTA	Europe	NO CASE	07/03/20	0,44	1454,04	21,30	4,49	06/01/21	227	3,3753
27	PORTUGAL	Europe	NO CASE	02/03/20	10,20	112,37	22,80	3,39	01/01/21	6972	3,4596
28	LUXEMBOURG	Europe	NO CASE	29/02/20	0,62	231,45	14,40	4,51	30/12/20	495	3,7333
29	NETHERLANDS	Europe	NO CASE	27/02/20	17,13	508,54	20,00	3,32	28/12/20	11042	3,7487
30	LITHUANIA	Europe	NO CASE	28/02/20	2,73	45,13	20,60	6,56	29/12/20	1347	3,7622
31	CHILE	South America	NO CASE	03/03/20	19,11	24,28	12,20	2,11	02/01/21	16724	4,0224
32	IRELAND	Europe	0 / 1 = 0%	29/02/20	4,94	69,87	14,60	2,96	30/12/20	2226	4,3753
33	SWITZERLAND	Europe	0 / 1 = 0%	25/02/20	8,68	214,24	19,10	4,53	26/12/20	7193	4,6400
34	POLAND	Europe	NO CASE	04/03/20	37,85	124,03	18,70	6,62	03/01/21	29119	5,0224
35	USA	North America	0 / 27 = 0%	21/01/20	331,03	35,61	16,60	2,77	21/11/20	261772	5,1172
36	SWEDEN	Europe	0 / 5 = 0%	31/01/20	10,10	24,72	20,30	2,22	01/12/20	7292	5,1175
37	CZECH REP.	Europe	NO CASE	01/03/20	10,71	137,18	20,10	6,63	31/12/20	11656	5,2733
38	FRANCE	Europe	1 / 7 = 14,29%	24/01/20	65,30	122,58	20,80	5,98	24/11/20	50237	5,5491
39	BELGIUM	Europe	NO CASE	04/02/20	11,60	315,56	19,30	5,64	05/12/20	17142	9,3295
40	UK	Europe	0 / 4 = 0%	31/01/20	67,90	272,90	18,70	2,54	01/12/20	59051	11,1674
41	SLOVENIA	Europe	NO CASE	04/03/20	2,09	102,62	20,70	4,50	03/01/21	2803	11,5379
42	ITALY	Europe	0 / 4 = 0%	31/01/20	60,48	205,86	23,30	3,18	01/12/20	56361	12,1514
43	HUNGARY	Europe	NO CASE	04/03/20	9,70	108,04	20,20	7,02	03/01/21	9884	13,6797
44	SPAIN	Europe	0 / 1 = 0%	31/01/20	46,76	93,10	20,00	2,97	01/12/20	45511	29,0983

Source: Author (2020)

c) The 44 countries' FTI305 average is 3.6818 (S=5.34; CV=144.98%), and the median equals 2.2341, with twenty-seven countries FTI305 average lower than the 3.6818. The 20 best countries's FTI305 average is 0.2733 (S=0.34; CV=124.11%), and the median equals 0.13805, with 12 countries FTI305 average lower than 0.2733. The 10 best countries's FTI305 average is **0.03542** (S=0.039; CV=109.37%), and the median equals **0.02316**, with 6 countries FTI305 average lower than 0.03542;



d) The ten countries with the highest population density are: 1) Singapore (7915.73 people/Km<sup>2</sup>), 2) HK (7039.71), 3) Malta (1454.04), 4) Taiwan (673), 5) SK (527.97), 6) Netherlands (508.54), 7) Israel (402.61), 8) Japan (347.78), 9) Belgium (315.56), and 10) Vietnam (308.13). When compared with the 10 best countries' FTI305 average (**0.03542**), special attention should be made to Taiwan (0.0019), Vietnam (0.0035), and Singapore (0.0168) because their FTI305 are lower than 0.0342, indicating that they are the best in facing the pandemic in areas with a high level of people living close to each other;

e) The ten countries with the highest percentage of people over 65 (2020) are: 1) Japan (28.4%), 2) Italy (23.3%), 3) Portugal (22.8%), 4) Finland (22.6%); 5) Greece (22.3%), 6) Germany (21.7%), 7) Malta (21.3%), 8) France (20.8%), 9) Latvia (20.7%), and Slovenia (20.7%). When compared with the 10 best countries' FTI305 average (**0.03542**), only Japan (FTI305=0.0862) has the FTI305 lower than 0.03542, which indicates that this country is the best to protect older people against the Covid-19.

RANK	FTI60-2M	FTI91-3M	FTI121-4M	FTI152-5M	FTI182-6M	FTI213-7M	FTI243-8M	FTI274-9M	FTI305-10M
1	VIETNAM	VIETNAM	VIETNAM	VIETNAM	VIETNAM	TAIWAN	TAIWAN	TAIWAN	TAIWAN
2	THAILAND	TAIWAN	TAIWAN	TAIWAN	TAIWAN	VIETNAM	VIETNAM	VIETNAM	VIETNAM
3	TAIWAN	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND	THAILAND
4	UAE	HK	HK	CHINA	CHINA	CHINA	CHINA	CHINA	CHINA
5	SINGAPORE	SINGAPORE	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	MALAYSIA	SINGAPORE	SINGAPORE
6	JAPAN	JAPAN	CHINA	HK	SINGAPORE	SINGAPORE	SINGAPORE	MALAYSIA	SK
7	AUSTRALIA	CHINA	SINGAPORE	SINGAPORE	AUSTRALIA	SK	SK	SK	MALAYSIA
8	MALAYSIA	MALAYSIA	AUSTRALIA	AUSTRALIA	SK	SK	SK	SK	SK
9	HK	AUSTRALIA	SK	SK	SK	JAPAN	JAPAN	JAPAN	JAPAN
10	USA	SK	SK	SK	JAPAN	CYPRUS	HK	HK	HK
11	SK	SK	JAPAN	JAPAN	HK	HK	CYPRUS	AUSTRALIA	AUSTRALIA
12	CHINA	UAE	CYPRUS	CYPRUS	CYPRUS	AUSTRALIA	ICELAND	UAE	UAE
13	FINLAND	QATAR	UAE	UAE	ICELAND	ICELAND	UAE	CYPRUS	ICELAND
14	CANADA	CYPRUS	LATVIA	ICELAND	LATVIA	LATVIA	AUSTRALIA	NORWAY	QATAR
15	QATAR	LATVIA	ICELAND	LATVIA	UAE	UAE	NORWAY	ICELAND	FINLAND
16	GERMANY	ICELAND	MALTA	MALTA	GREECE	NORWAY	LATVIA	FINLAND	NORWAY
17	SK	GREECE	GREECE	GREECE	CZECH REP	LITHUANIA	FINLAND	QATAR	CYPRUS
18	CYPRUS	ISRAEL	ISRAEL	CZECH REP	MALTA	GREECE	QATAR	ESTONIA	DENMARK
19	LATVIA	MALTA	QATAR	ISRAEL	NORWAY	QATAR	ESTONIA	GERMANY	ESTONIA
20	CHILE	CZECH REP	CZECH REP	NORWAY	LITHUANIA	FINLAND	LITHUANIA	DENMARK	GERMANY
21	MALTA	FINLAND	NORWAY	QATAR	QATAR	CZECH REP	GREECE	LATVIA	ISRAEL
22	ISRAEL	LITHUANIA	LITHUANIA	LITHUANIA	FINLAND	ESTONIA	AUSTRIA	ISRAEL	CANADA
23	GREECE	POLAND	POLAND	FINLAND	ESTONIA	FINLAND	DENMARK	LITHUANIA	LATVIA
24	CZECH REP	NORWAY	FINLAND	ESTONIA	POLAND	POLAND	GERMANY	GREECE	GREECE
25	ICELAND	ESTONIA	ESTONIA	POLAND	ISRAEL	DENMARK	POLAND	AUSTRIA	AUSTRIA
26	POLAND	CHILE	AUSTRIA	AUSTRIA	AUSTRIA	GERMANY	MALTA	CANADA	MALTA
27	FRANCE	AUSTRIA	SLOVENIA	DENMARK	DENMARK	ISRAEL	ISRAEL	MALTA	PORTUGAL
28	LITHUANIA	GERMANY	DENMARK	SLOVENIA	SLOVENIA	MALTA	LUXEMBOURG	PORTUGAL	LUXEMBOURG
29	NORWAY	SLOVENIA	GERMANY	GERMANY	GERMANY	SLOVENIA	PORTUGAL	LUXEMBOURG	NETHERLANDS
30	SWEDEN	DENMARK	PORTUGAL	HUNGARY	HUNGARY	LUXEMBOURG	SWITZERLAND	SWITZERLAND	LITHUANIA
31	ESTONIA	CANADA	HUNGARY	LUXEMBOURG	PORTUGAL	PORTUGAL	CZECH REP	NETHERLANDS	CHILE
32	AUSTRIA	PORTUGAL	LUXEMBOURG	PORTUGAL	LUXEMBOURG	HUNGARY	SLOVENIA	POLAND	IRELAND
33	DENMARK	HUNGARY	SWITZERLAND	SWITZERLAND	SWITZERLAND	SWITZERLAND	CANADA	CHILE	SWITZERLAND
34	SLOVENIA	LUXEMBOURG	CANADA	CANADA	CANADA	CANADA	NETHERLANDS	CZECH REP	POLAND
35	UK	USA	CHILE	NETHERLANDS	NETHERLANDS	NETHERLANDS	HUNGARY	FRANCE	USA
36	HUNGARY	SWITZERLAND	USA	CHILE	CHILE	CHILE	CHILE	IRELAND	SWEDEN
37	PORTUGAL	NETHERLANDS	NETHERLANDS	USA	USA	FRANCE	FRANCE	SWEDEN	CZECH REP
38	LUXEMBOURG	SWEDEN	FRANCE	FRANCE	FRANCE	USA	IRELAND	USA	FRANCE
39	SWITZERLAND	FRANCE	SWEDEN	IRELAND	IRELAND	IRELAND	USA	SLOVENIA	IRELAND
40	BELGIUM	IRELAND	IRELAND	SWEDEN	SWEDEN	SWEDEN	SWEDEN	BELGIUM	UK
41	NETHERLANDS	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM	BELGIUM	HUNGARY	SLOVENIA
42	IRELAND	UK	UK	ITALY	UK	UK	UK	ITALY	ITALY
43	ITALY	ITALY	ITALY	UK	UK	UK	UK	UK	HUNGARY
44	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN	SPAIN

Chart 4: Position of each country over time by FTI ascending order

Source: Author

When the evolution of FTI of each country is investigated over time (Chart 4 and 5) since the second month facing the pandemic (FTI60=2 Months, FTI91=3M, FTI121=4M ... FTI305=10M) it was noted that:

a) Taiwan, Vietnam, and Thailand are the best country with the lowest FTI value, they were able to keep the top 3 positions over time. Among them, Taiwan was the best (Chart 4) to reduce the FTI value,



from FTI60 = 0.0028 to FTI305 = 0.0019 (Chart 5);

b) On the other hand, Spain, Italy, and the UK are the countries with the highest FTI over time;

c) New Zealand FTI evolution during 10 month is considered outstanding, since this country continually reduces the FTI, going from FTI60 = 0.1140 (17th position in the 2nd month) to FTI305=0.0295 (6th position in the 10th Month). Another good example are Iceland and Norway;

d) USA FTI evolution is considered inferior since this country's position dropped significantly from 10th position in the second month (0.0374) to 35th position in the 10th month (FTI305 =5.1172). USA is an example of how a nation with a good Health Security Index (NTI, JHU, and EIU, 2019) can lost millions of lives during a pandemic due to lack of leadership and bad behaviors of the President, as shown by Silva (2020b p. 137).

COUNTRIES	FTI60-2M	FTI91-3M	FTI121-4M	FTI152-5M	FTI182-6M	FTI213-7M	FTI243-8M	FTI274-9M	FTI305-10M
TAIWAN	0.0028	0.0055	0.0049	0.0039	0.0032	0.0028	0.0024	0.0021	0.0019
VIETNAM	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0044	0.0039	0.0035
THAILAND	0.0003	0.0081	0.0085	0.0070	0.0058	0.0050	0.0044	0.0039	0.0036
CHINA	0.0412	0.0313	0.0330	0.0263	0.0219	0.0187	0.0164	0.0146	0.0131
SINGAPORE	0.0061	0.0241	0.0345	0.0313	0.0272	0.0232	0.0203	0.0187	0.0168
NZ	0.1140	0.0870	0.0655	0.0521	0.0435	0.0423	0.0370	0.0328	0.0295
MALAYSIA	0.0113	0.0366	0.0323	0.0271	0.0230	0.0200	0.0186	0.0284	0.0385
SK	0.0411	0.0680	0.0570	0.0483	0.0427	0.0378	0.0408	0.0428	0.0431
JAPAN	0.0065	0.0291	0.0804	0.0845	0.0755	0.0713	0.0833	0.0840	0.0862
HK	0.0178	0.0117	0.0132	0.0281	0.1128	0.1290	0.1152	0.1051	0.1180
AUSTRALIA	0.0097	0.0467	0.0445	0.0364	0.0423	0.1310	0.1893	0.1756	0.1581
LAO	0.0036	0.0966	0.2259	0.2193	0.2032	0.1902	0.1813	0.1836	0.1993
ICELAND	0.5610	0.3699	0.2782	0.2215	0.1850	0.1580	0.1662	0.3194	0.3090
QATAR	0.0670	0.1457	0.3652	0.4414	0.4305	0.4037	0.3903	0.3475	0.3214
FINLAND	0.0477	0.5884	0.6745	0.5609	0.4699	0.4088	0.3650	0.3358	0.3349
NORWAY	0.8390	0.6468	0.5154	0.4202	0.3633	0.3175	0.2876	0.2888	0.3457
CYPRUS	0.2593	0.2052	0.1629	0.1297	0.1254	0.1169	0.1195	0.2575	0.4796
DENMARK	1.7373	1.5237	1.2186	0.9545	0.8370	0.7438	0.7123	0.7270	0.9637
ESTONIA	1.1897	0.9884	0.7433	0.5917	0.5020	0.4290	0.4289	0.5419	0.9970
GERMANY	0.1106	1.3729	1.3334	1.1228	0.9563	0.8308	0.7417	0.7082	1.0026
ISRAEL	0.4267	0.4266	0.3519	0.3936	0.6185	0.8316	1.3119	1.4001	1.4307
CANADA	0.0519	1.6910	3.1594	3.1661	2.7637	2.4148	2.1539	2.0626	2.2037
LATVIA	0.2860	0.2829	0.2659	0.2258	0.2004	0.1863	0.3134	0.5220	2.2646
GREECE	0.4782	0.4071	0.3380	0.2846	0.2918	0.3780	0.5119	1.5637	3.2335
AUSTRIA	1.5116	1.1986	0.9761	0.7926	0.6915	0.6244	0.6917	1.6470	3.2415
MALTA	0.3779	0.4485	0.3373	0.2685	0.3489	0.8517	1.3064	2.4993	3.3753
PORTUGAL	2.5401	2.3683	1.9750	1.7285	1.5151	1.4048	1.5614	2.5282	3.4596
LUXEMBOURG	3.4122	2.7806	2.0912	1.7252	1.5673	1.3392	1.4200	2.6194	3.7333
NETHERLANDS	7.7970	6.7169	5.2244	4.1861	3.5376	3.0986	3.0433	3.5021	3.7457
LITHUANIA	0.6247	0.6366	0.5491	0.4483	0.4025	0.3679	0.5048	1.4985	3.7622
CHILE	0.3399	1.0834	4.0614	4.6370	4.5631	4.4314	4.3009	4.1332	4.0224
IRELAND	11.7801	10.8041	8.5465	6.9336	5.8368	5.0605	4.6923	4.4896	4.3753
SWITZERLAND	5.2434	3.9523	2.9968	2.4037	2.0313	1.7938	1.7003	3.1544	4.6400
POLAND	0.5945	0.6446	0.6552	0.5994	0.6006	0.6431	1.2719	3.6149	5.0224
USA	0.0374	3.0421	4.8768	4.9091	4.7726	5.0242	5.0171	4.9564	5.1172
SWEDEN	1.1880	6.9507	8.1870	7.7410	6.7379	5.8276	5.1548	4.6896	5.1175
CZECH REP	0.5381	0.4822	0.3946	0.3450	0.3222	0.4269	1.8063	4.2302	5.2733
FRANCE	0.6176	8.2274	7.8912	6.5842	5.5888	4.8286	4.3615	4.2598	5.5491
BELGIUM	5.7102	15.0016	12.9559	10.5451	8.8725	7.7145	6.8611	7.3462	9.3295
UK	2.3312	17.3185	17.8449	15.3648	13.0537	11.2383	10.0033	9.8003	11.1674
SLOVENIA	2.0087	1.5038	1.1517	1.0077	0.9243	0.9136	2.0046	7.2945	11.5379
ITALY	13.6622	20.4542	18.2100	15.1165	12.7523	10.9544	9.7132	9.2680	12.1514
HUNGARY	2.3921	2.4771	2.0513	1.6580	1.4357	1.6092	3.2815	8.2022	13.6797
SPAIN	28.5101	55.1335	46.8179	37.7095	31.5826	27.6013	26.4389	26.5544	29.0983

Chart 5: FTI evolution of each country organized in ascending order of FTI305

Source: Author

#### 9.4 The BMP adopted in Taiwan to save lives against the Covid-19

Between 21st June and 9th November 2020, five Boost Posts run for a total of 70 days with the invitation and link of the questionnaire. The Posts reached 50.721 people living in Taiwan, from which 109 (0.21%) respondents accepted voluntarily to participate in the survey.

#### 9.4.1 Basic profile of the respondent

a) the respondents spent an average of 6min15s to answer the questionnaire;

b) most (104=95.4%) revealed the age, which average is 57 years old, the median age is 60 years old, the youngest respondent has 26 years old, and the oldest has 82 years old. This result indicates that adult and old people are more motivated to participate in the survey;

c) Most respondent (62=57%) is native of Taiwan, while 46 (42%) are foreigners living there. Only one person did not respond to the question. All foreigners accepted to inform the time living in Taiwan, with the average time being 15.7 years. Only 5 foreigners are living there for less than one year, with the lowest time living there being four months.

#### 9.4.2 Cultural practices

Only five respondents (4.59%) don't believe that cultural practices were decisive to the low rate of Covid-19 in Taiwan, while most (104=95.41%) believe in that.

From the group that believe (Figure 9), the most decisive cultural practices were: first) wear a mask (87.5%), 2nd) wash hands (55.77%), 3rd) cleanliness of public services (45.19%), 4th) not shake hands (38.46), 5th)) not hug in public (37.50%).

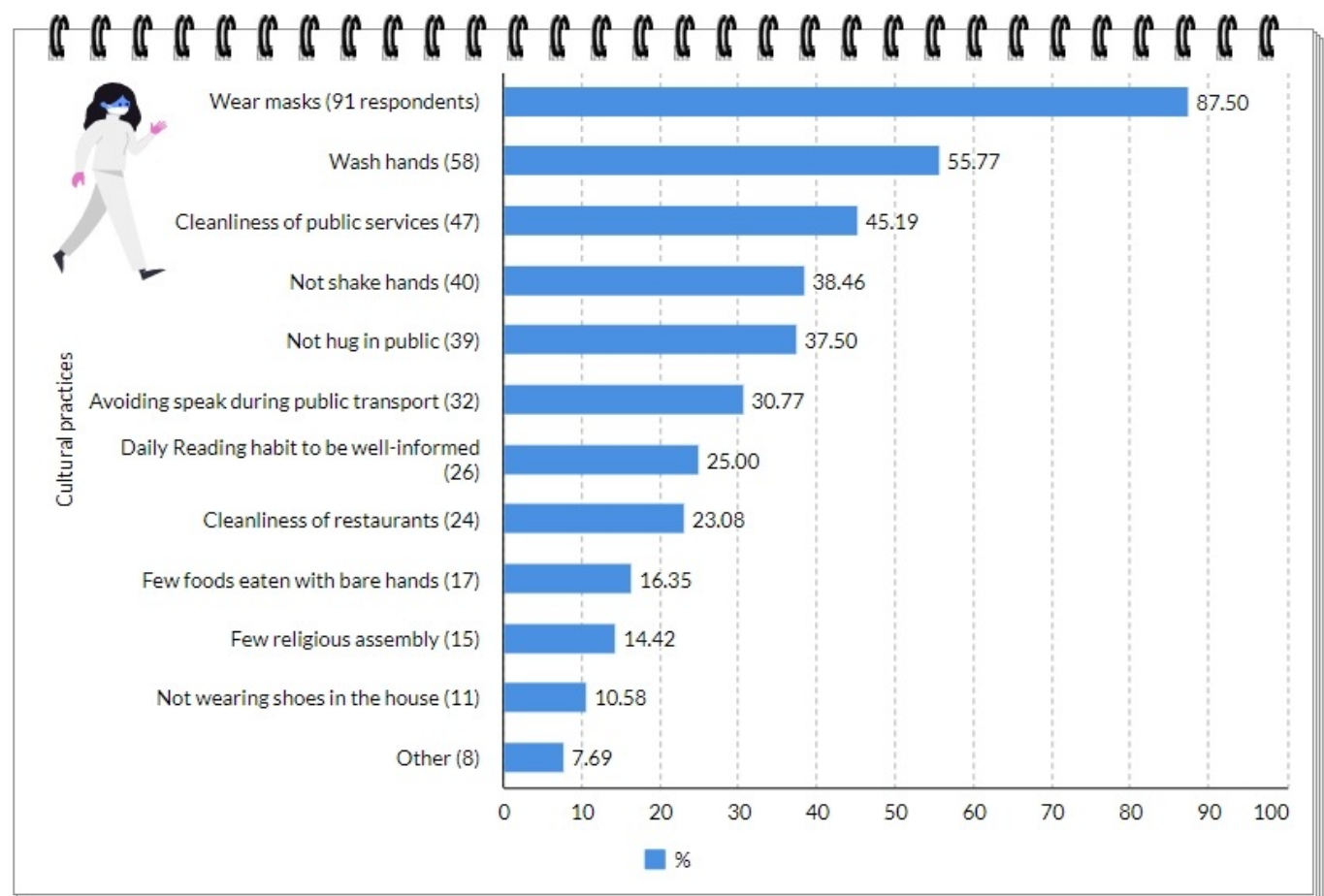


Figure 9: Perception of the 104 respondents that believes that cultural practices were decisive to reduce the rate of Covid-19 deaths in Taiwan

Source: Author (2020)

On the other hand, the less decisive were: 12th) not wearing shoes in the house (10.58), 11th) few religious assemblies, 10th) few foods eaten with bare hands (16.35), 9th) cleanliness of restaurants, 8th) daily reading habit to be well-informed, 7th) avoiding speak during public transport (30.77%). Only 8 (7.69%) responded to the option Others.

#### 9.4.3 Trust in the National Government

Most (108=99%) respondents rated from 0 to 10 the level of trust in official statistics released by the Taiwan National Government about the number of deaths cases by Covid-19.

Figure 10 shows that the average of trust is high ( $X=9.55$ ;  $S=1.24$ ;  $CV=12.98\%$ ) and the median is 10, with most (104=96.3%) of them giving a rate equal or over 8 points, and 3.70% giving a rate lower or equal to 7.

When the answers are compared by the foreigners and natives, only 2.17% of foreigners rated equal to or lower than 7, while 4.84% of native did so.

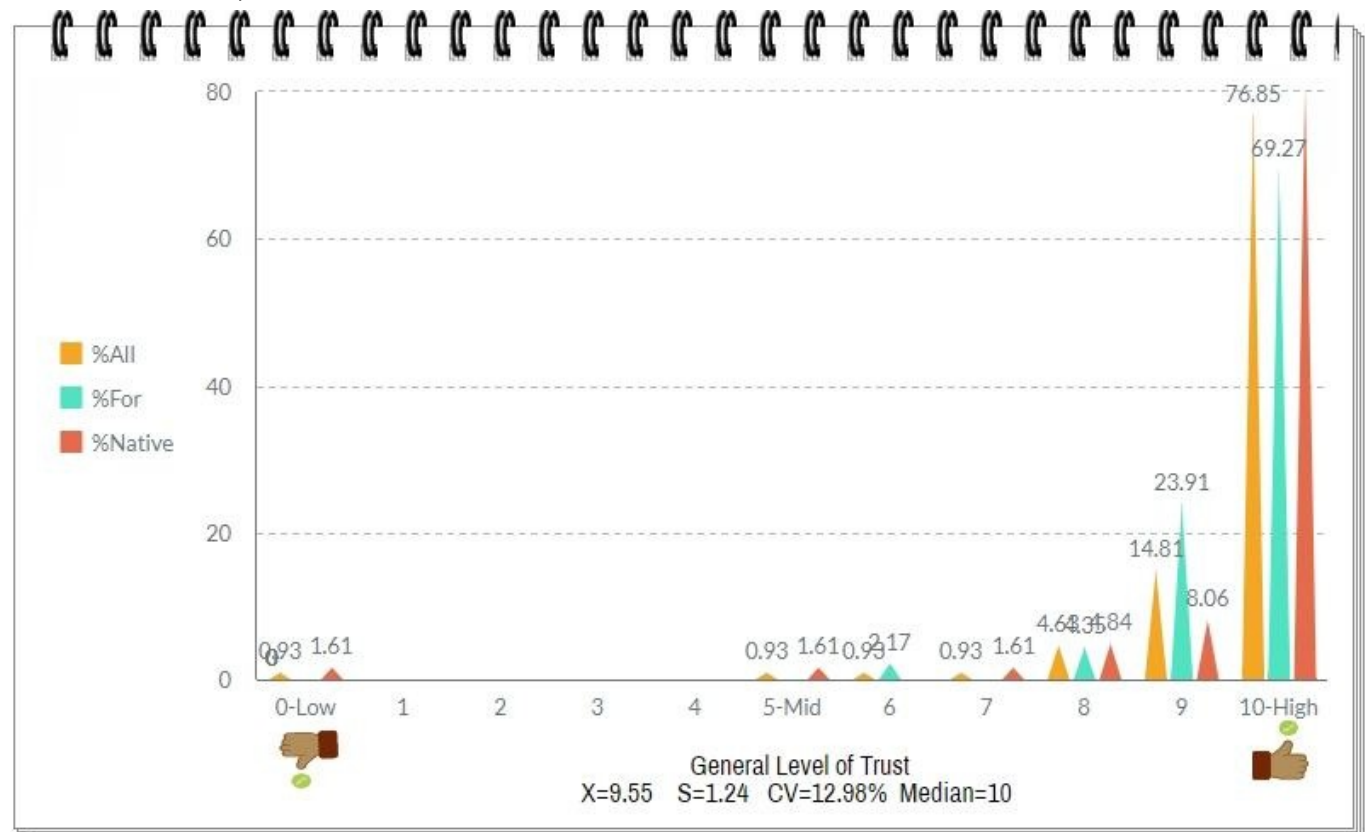


Figure 10: Level of trust of the 108 respondents in Taiwan National Government about the official number of deaths cases by Covid-19

Source: Author (2020)

#### 9.4.4 The perception of the respondents on the main policy measures adopted that saved lives

Several authors and organizations (BALAJEE et al, 2017; HA et al, 2020; IMF, 2020; JONES, 2020; OCDE, 2020; OUR WORLD IN DATA, 2020; PANG, 2003; ROSER et al, 2020; SVOBODA et al, 2004; WHO, 2020c) focused on policies, responses, or measures against the Coronavirus.



In this research, firstly it was aimed to identify the respondent perceptions about the subject, and later, with further research, it was organized the main policies, programs, projects adopted by Taiwan National Government and partners.

Concerning the respondents' perception, all of them selected at least one (multiple choice) of 18 measures provided.

As a result, Figure 11 shows that for the 109 respondents, the ten main policy measures adopted by the Taiwan Government that saved lives against the Covid-19 are:

1st) international travel control (77.98%), 2nd) effective public-private collaboration (60.55%), 3rd) public information campaigns (52.29%), 4th) integration with mass media (51.38), 5th) increase the medical and personal equipment capacity (48.62%), 6th) combat fake news (46.79%), 7th) public event cancellations (44.95%), 8th) improve intensive care unit structure (28.44%), 9th) support the expansion of the testing system (20.18%), and schools closures (15.60%).

On the other hand, the five policies measures considered less voted by the respondents to save people lives are: 18th) low-interest loans (2.75%), 17th) workplaces closure (4.59%), 16th) online training programs (7.34%), 15th) public transport reduction (8.26%), and 14th) Tax relief (9.17%).

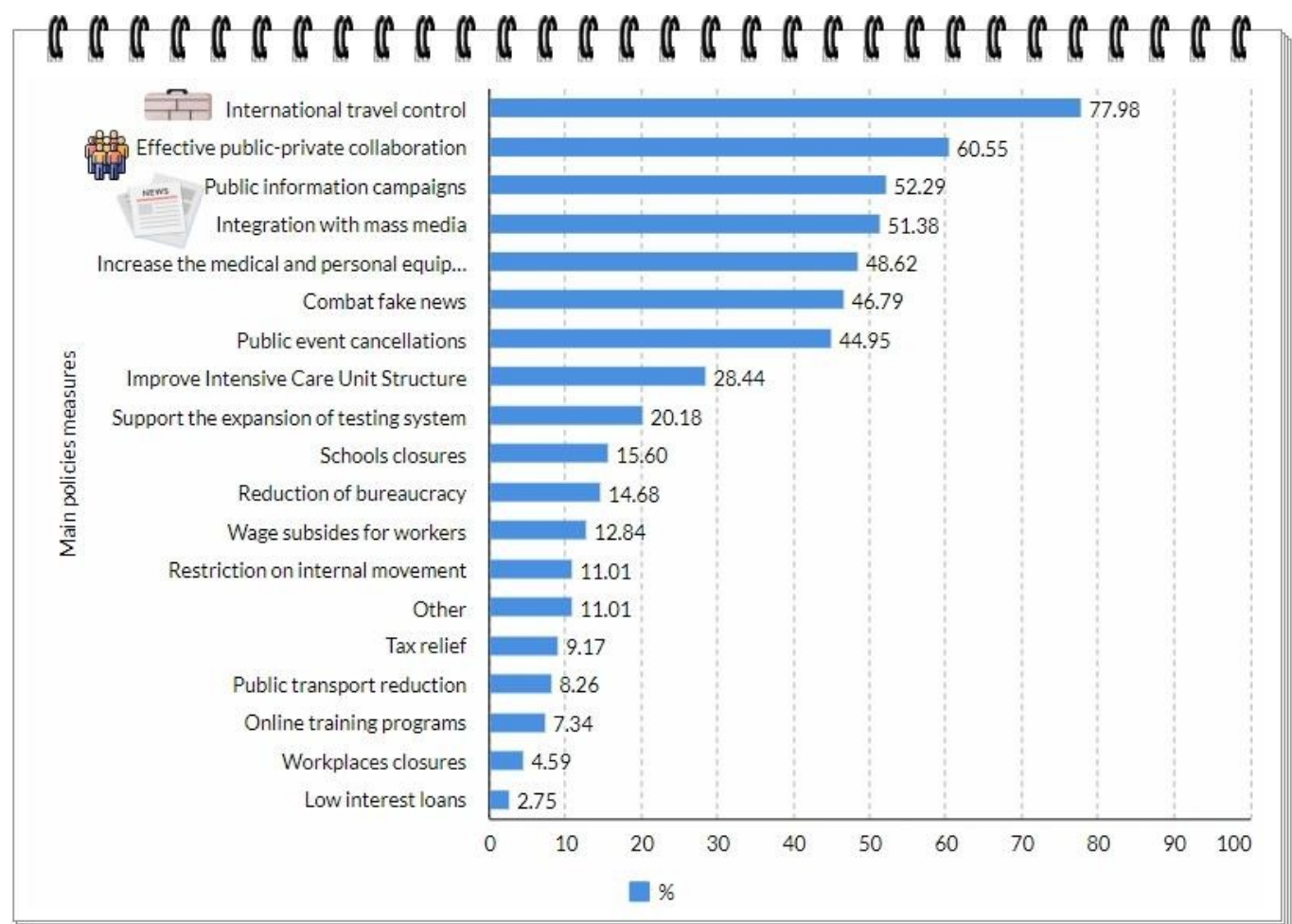


Figure 11: Perceptions of the 109 respondents on the main policies that saved lives in Taiwan

Source: Author (2020)

#### 9.4.5 The most innovative products or services used in Taiwan against Covid-19

For question 5 of the questionnaire, the respondent was asked, if know, to write the name of the most innovative products or services that are protecting people in Taiwan against the Covid-19.

Analyzing the answers, it was noted that: most (75=68.8%) respondent tried to inform what they believed as innovative products or services, while 28 (25.69%) respondents did not answer the question, 4 (3.67%) respondents informed that they did not know, and only 2 (1.83%) informed that there was no innovative products or services.

In technical terms, from the 75 respondents that tried to explain the innovative solutions, fourteen (19%) informed the name of the products or services.

However, the main aim of this question was not to evaluate the respondent ability in innovation issues but to find tips of products or services that respondents perceived as new during the pandemic, and from them, to search on the internet the details of the organization, solution name, goal, technologies adopted.

For the 75 respondents, the perceptions about the most innovative products or services are related to: Face Masks (18=24%), Apps for contact tracing or electronic fencing (13=17.33%), Adequate National Supply System of Masks (7=9.33%), App (e-Mask Ordering System) for Mask Purchase (7=9.33%), Public health daily information (7=9.33%), Public cooperation (6=8%), Telehealth equipment (6=8%), National Health Care System (6=8%), CDC Management System supported by Central Government (4=5.33%), Temperature (Thermometers) check in shops, workplace, etc (4=5.33%), Wash hands products (alcohol, soap or sanitizers; 4 = 5.33%), Test Kits (4 = 5.33%), Entry Quarantine System during entry inspection (3=4%), Quarantine (3 = 4%), Social distance (2=2.67%), Websites (2=2.67%), Early restrictions (2=2.67%), School closures (2=2.67%), Anti-epidemic battle campaign (1), Crisis Awareness (1), Disease Management Agency (1), Isolation of positive cases and those exposed to them (1), law enforcement such as mandatory use of masks in public transport (1), QR Code solutions (1).

From these tips, a spreadsheet was developed to insert new data from the complementary research on the internet to identify the innovative solutions, with the following fields: 1) organization and solution, which describes the name of the organization and the solution developed; 2) type, divided into Corporation, Public Sector, Start-Up, University, and Other; 3) contact, informing the e-mail or link for contact; 4) site; 5) city where it was developed or applied; 6) stage, divided into In Preparation, Pilot/Demo/Trial, or Ready; 7) category, that classifies the solution as Prevention, Diagnostic, Treatment, Grants & Support Initiatives, Information, and Life & Business Application, by using the criteria of the Start-Up Blink (2020); 8) subcategory with subtopics for each category, by using the criteria of the Start-Up Blink (2020); 9) technology used; 10) resume, which describes the main information of the solution.

As a result, from June until the middle of December 2020, it was found 250 responses in Taiwan, with the majority led by Public Sector (149=59.6%), Corporation (67=26.8%), followed by Others (14=5.6%), Start-Up (10=4%), and University (10=4%).

Concerning the location, the most solution comes from the capital of Taiwan (Taipei) or New Taipei (205=82%), followed by the other cities (Hsinchu=4%, Taichung=2%, Changua=1.6%, Taoyuan=1.6%, Kaohsiung=1.2%, and others).

Concerning to stage, during the period of data collection, most (233=93%) response is Ready, 14

(5.6%) are in Pilot/Demo/Trial (including vaccines), and 3 (1.2%) are in Preparation.

The policies, measures, programs or projects identified are strongly related to Financial Aid (54 responses), followed by Electronic guidelines (16), Act/Law/Regulations (9), Training (9), Quarantine (9), Consumption Stimulus (8), Suspension of events (5), Employment incentives (5), NHI System (5), Fine/Penalties (5), Temporary Ban (5), Donation (3), Refund (3), Delay/Postponed payment (3), Partnerships (3), Daily Press Conferences (2), Adjustment in Production Structure (2), Digital Trade (2), Fuel Subsidy (2), Flexible work hours (2), Insurance (2), Rent deferral or reduction (2), Repair or Maintenance (2), Audits (2), Border Control (2), Campaign (2), Temperature check (2), National Mask Team (1), Preparedness & Contingency Plan in Response to Covid-19 Epidemic (1), National Laboratory System (1), Free Influenza Vaccines (1), Social Distance (1), R&D Team (1), Smartlabs (1), Hackathon (1), Ban export of mask (1), Relax advertisement time (1), National Inspection Network (1), Community collection and inspection network (1), Food kit (1), Investment in new structure (1), Labor pension (1), Grants for work allowances (1), Lift export mask ban (1), National mask team (1), Hotel Subsidy (1), Care Centers (1), Stockpiling framework (1), System unification (1), Technical exchange (1), Customs assistance (1), Suspend group tours (1), Disinfection Task Force (1), Entrepreneurial consulting (1), and Volunteers (1).

In terms of Products or Services, most is related to the development or improvement of Test Kits (17), Robots (15), Apps (14) and Masks (10), followed by Thermal imaging cameras (4), Vaccines (4), Name-based Mask Distribution System 1.0, 2.0 and 3.0 (3), Thermometers (3), Sprays (3), Gowns (3), Wipes (2), Ventilators (2), Reagents (2), Laboratory System Network (1), Medical image analysis equipment (2), Drugs (2), Alcohol (2), Smart Mirror (1), Epidemic Prevention Supplier System (1), National Infectious Disease Statistic System (1), Flu Forecast Map, National & Regional Forecast platform (1), Taiwan Nosocomial Infections Surveillance System (1), PTT Bulletin Board System (1), Single-payer System (1), Servo controlled flow generator (1), Sales Model System (1), Respiratory humidifier (1), Protective clothing (1), Nasopharyngeal Swabs (1), Music Platform (1), Mobile phone visitation software (1), Lung auscultation (1), iodines (1), Intensive care ward (1), Intelligent management system (1), Glasses (1), Face Shield (1), Electrochemical sensing devices (1), Electric motorcycles (1), Drug inventory system (1), Door with automatic detection (1), Digital door sign (1), Breathing tube made by silicon (1), and Blood collection device.

Concerning to the technologies or method used to develop the products or services, it is important to notice that the use of internet is present in all of them, followed by the use of Artificial Intelligence (14), QR Code (11), Cloud System (8), Data center-data mining, database (8), UV (8), IoT (6), ID Chip Cards (6), e-commerce (5), Nucleic acid amplification technology (5), Mobile payment (5), Nano technologies (5), Video Technologies (5), Bluetooth (4), Antibody rapid detection test methods (3), SMS (3), GPS (2), iiPCR technology (2), Telephones (2), Fiber optic (2), Face recognition technologies (2), Chat Bot (2), Ultrasonic sensors (2), 3D technology (2), IR camera technology (2), Modular Assembly Design (2), Remote consultation or monitoring technologies (2), TV satellite or platform (2), KFFVirus RT-qPCR Master Mix, In Vitro Diagnostic Device methods (1), Electronic Bulletin Board System (1), Cartoon printing (1), Biosensor Chip (1), Infrared thermometers technology (1), Citizen Digital Certificate (1), Facial temperature sensor (1), Digital one step RT-qPCR platform (1), Laser guiding technology (1),



Gene detection assay (1), Genome Sequence (1), GGHH Aawrd, Genetically modified Spike protein (1), Electronics forms (1), LFIA method (1), Chest X-ray technology (1), Chemical coverall (1), Cell Broadcast Service (1), Blockchain (1), 4G (1), qPCR (1), TELnet protocol (1), Traffic Bundle Control (1), Microfluidic immunoassay cartridge (1), Machine vision (1), Radio Station (1), RT – qPCR (1), Machine learning (1), Microporous film laminate (1), N gene (1), nFOPT smart care film (1), Optical Radar (1), Triage (1), Oxygen Therapy (1), Otorhinolaryngology diagnosis (1), PCR (RT-PCR) technology (1), RdRP (1).

It is important to notice that the number that appears in parenthesis in each product, service, technology, or method should be much higher because during the collection of data, in many cases, it was not clear the description of the technology or method used by the product or service.

In terms of Category, most the 250 responses is focused on Prevention (91=36.4%), Grants & Support Initiatives (55=22%), followed by Diagnostic (40=16%), Life & Business Adaptation (33=13.2%), Information (24=9.6%), and Treatment (7=2.8%).

Some examples of Prevention responses are Border Control, Plans to protect citizens returning from high-risk regions, Full external gas introduction cycle heat exchange health energy-saving air conditioning system, Mask Map, Disinfection Gateway, Automated dispensed cabinet, iMRobot, eMask Ordering System, Infrared Thermal Cameras in the train stations, suspended group tours, postponed Taipei International Book Fair and protect the rights of the exhibitors and ticket buyers, etc

Some examples of Grants & Support Initiatives are Donation of Non-Contact Forehead Thermometers, Cohak Hackathon, Buy More with Triple Stimulus Voucher Program, Guaranteed Salary Program, GU Talent for Training Program, Upgrade for Innovation and R&D Program, Taiwan Can Help for International Support, Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens, Automobile Transport Industry Relief Measures, Aviation Industry Relief 1.0; 2.0 and 3.0, Epidemic Prevention Quarantine Hotels, Hotel industry employee salary subsidy program, Tourism Industry Relief 1.0; 2.0 and 3.0 Program, Art and Literature Relief 1.0 and 2.0, Phoenix loan for micro-entrepreneurship and repayment buffer, etc.

Finally, all the 250 responses are shown in Chart 6 (Appendix)

## **10. Conclusions and recommendations (Golden lessons)**

The main aim of the article is to investigate the performance and the best management practices adopted in Taiwan to save lives, during the first 305 days facing the pandemic.

From the data collection and analysis, the main lessons and recommendations are:

1) Over time WHO developed models to help countries to prepare and respond to epidemics or pandemic. Concerning Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b), it is shorter with only 12 pages with different emphasis to the following components when compared with WHO models: Activation Protocol for Preparedness and Contingency Planning, Implementation of Border Quarantine, Inventory checking of medical supplies and equipment, Tightening border quarantine, Perfecting (or improving) the Health System, Enhance testing and

diagnostic capabilities, Community based epidemic prevention, and Developing International collaboration. Further research should be done to grasp each component;

2) two basic Taiwan Models for fighting the Covid-19 were found, one provided by TAITRA (2020) which seems to follow the Taiwan Preparedness and Contingency Planning in Response to Covid-19 Epidemic (TCDC, 2020b), it is more broad in scope with the participation of several stakeholders. The other model is provided by Taiwan MOHW, more focused to share the lessons learned from SARS2003 and Public Health Measures adopted by the MOHW over time. The 250 responses found in this research should open the discussion for the improvement of these models or the development of a new model to cover all the aspects of Taiwanese Society, including solutions provided by Universities, SMEs, Schools, Start-Ups, R&D Institutes, and NGOs;

3) over the last twenty years (2000-2020), Taiwan had 3 presidents, 5 vice presidents, and at least 10 Ministers of MOHW. In general, it was found that these leaders have a good education background, all have graduation, 61% Master Degree and 50% Doctor degree, with a strong emphasis on Law or Medicine related areas, which may have contributed to the improvement of legal, educational and scientific structures, as well as the development of a society with a strong respect for legal practices, science and for medical professionals. Besides the educational background, the experience and the leadership by example are crucial to unify the country against any crisis, especially those related to the epidemic or pandemic. Further research should be done to grasp these leaders background and their leadership style to provide management guidance to top public managers;

4) Pandemic preparedness can not be effective only adopting short term measures. Several responses identified in this research were not deployed in 2020, but over time. For example, concerning the act, laws, or regulations, Taiwan has developed a framework for detecting and reporting epidemics per International Health Regulations (LEE, 2020b). At least, nine legal norms have been used (partially or totally) over time to better prepare and respond to epidemic or pandemic in Taiwan, with three enacted during the Covid-19 pandemic. Besides, the Taiwan Constitutional Court recommendations were vital for the improvement of the Communication Disease Control Act, considered the main legal basis to fight the Covid-19 (CHANG, 2020). Other examples are National Testing Network, National Laboratory Influenza Surveillance Network, National Laboratory System, National Notifiable Diseases Surveillance System, Nosocomial Infections Surveillance System, as well as improvement made in Taiwan CDC (NHCC and CECC), Hospitals, Universities, Companies, and Local Governments, which investments and operational best practices should be considered for future research;

5) Concerning the 44 countries performance, when is considered the real estimated number of Covid-19 fatal cases by one million population during the first 10 months facing the pandemic, Taiwan is the best country, with the lowest FTI305 due to the National Government ability to improve their legal, health care and industrial systems, as well as integrate and heavily support main actors of the nation to prevent, prepare and fight against the Covid-19. However, there are some area for improvement in Taiwan, such as criminal penalties for violating quarantine, economic support for quarantined citizens, travel restrictions, legislative efficiency, covid-19 equipment availability (DEEP KNOWLEDGE GROUP, 2020 p. 151), reason by which new research should focus on these areas;

5) to get public support, the government needs to provide information transparently. In Taiwan, it was possible by a) employing multiple media channels to timely announce information to keep the public informed; b) providing access to the NHI database for public and private sectors to fight the pandemic; c) combating fake news; d) using digital technologies to communicate with people with fast, fair and fun strategies. As a result, when the each respondent was asked to rate from 0 to 10 the level of trust in official statistics released by the Taiwan National Government about the number of deaths cases by Covid-19, 108 respondent evaluated as high ( $X=9.55$ ;  $S=1.24$ ;  $CV=12.98\%$ ) with the median equal to 10, with most ( $104=96.3\%$ ) of them giving a rate equal or over 8 points;

6) Only five respondents (4.59%) don't believe that cultural practices were decisive to the low rate of Covid-19 in Taiwan, while most ( $104=95.41\%$ ) believe in that. From the group that believes, the most decisive cultural practices were: first) wear a mask (87.5%), 2nd) wash hands (55.77%), 3rd) cleanliness of public services (45.19%), 4th) not shake hands (38.46), 5th) not hug in public (37.50%). On the other hand, the less decisive were: 12th) not wearing shoes in the house (10.58), 11th) few religious assemblies, 10th) few foods eaten with bare hands (16.35), 9th) cleanliness of restaurants, 8th) daily reading habit to be well-informed, 7th) avoiding speak during public transport (30.77%). Only 8 (7.69%) responded to the option Others;

7) For 109 respondents, the ten main policy measures adopted by the Taiwan Government that saved lives against the Covid-19 are: 1st) international travel control (77.98%), 2nd) effective public-private collaboration (60.55%), 3rd) public information campaigns (52.29%), 4th) integration with mass media (51.38), 5th) increase the medical and personal equipment capacity (48.62%), 6th) combat fake news (46.79%), 7th) public event cancellations (44.95%), 8th) improve intensive care unit structure (28.44%), 9th) support the expansion of the testing system (20.18%), and schools closures (77.98%). On the other hand, the five policies measures considered less voted by the respondents are 18th) low-interest loans (2.75%), 17th) workplaces closure (4.59%), 16th) online training programs (7.34%), 15th) public transport reduction (8.26%), and 14th) Tax relief (9.17%);

8) 250 responses against the Covid-19 were found in Taiwan. Public Sector and Corporations are playing important roles, followed by Others, Start-Up and University. Concerning to stage, during the period of data collection, the most response is Ready, 14 are in Pilot/Demo/Trial (including vaccines), and 3 are in Preparation. In addition, the policies, measures, programs or projects identified is strongly related to Public Financial Aid, followed by Electronic guidelines, Act/Law/Regulations, Training, Quarantine, Consumption Stimulus, Suspension of events, Employment incentives, NHI System, Fine/Penalties, Temporary Ban, Donation, Refund, Delay/Postponed payment, Partnerships, Daily Press Conferences, Adjustment in Production Structure, Digital Trade, Fuel Subsidy, Flexible work hours, Insurance, Rent deferral or reduction, Repair or Maintenance, Audits, Border Control, Campaign, Temperature check, National Mask Team, Preparedness & Contingency Plan in Response to Covid-19 Epidemic, National Laboratory System, Free Influenza Vaccines, Social Distance, R&D Team, Smartlabs, Hackathon, Ban export of mask, Relax advertisement time, National Inspection Network, Community collection and inspection network, Food kit, Investment in new structure, Labor pension, Grants for work allowances, Lift export mask ban, National mask team, Hotel Subsidy, Care Centers, Stockpiling framework, System unification, Technical exchange, Customs assistance, Suspend group

tours, Disinfection Task Force, Entrepreneurial consulting, and Volunteers. New research should be done to investigate the impact of these policy measures on the country economy;

9) In terms of Innovative Products or Services, most is related to the development or improvement of Test Kits, Robots, Apps and Masks, followed by Thermal imaging cameras, Vaccines, Name-based Mask Distribution System 1.0, 2.0 and 3.0, Thermometers, Sprays, Gowns, Wipes, Ventilators, Reagents, Laboratory System Network, Medical image analysis equipment, Drugs, Alcohol, Smart Mirror, Epidemic Prevention Supplier System, National Infectious Disease Statistic System, Flu Forecast Map, National & Regional Forecast platform, Taiwan Nosocomial Infections Surveillance System, PTT Bulletin Board System, Single-payer System, Servo controlled flow generator, Sales Model System, Respiratory humidifier, Protective clothing, Nasopharyngeal Swabs, Music Platform, Mobile phone visitation software, Lung auscultation, iodines, Intensive care ward, Intelligent management system, Glasses, Face Shield, Electrochemical sensing devices, Electric motorcycles, Drug inventory system, Door with automatic detection, Digital door sign, Breathing tube made by silicon, and Blood collection device;

10) Internet and digital solutions are playing important roles to save lives during the Covid-19 pandemic. The main technologies and methods related to the 250 best management practices found in this research are: Artificial Intelligence, QR Code, Cloud System, Data center-data mining, database, UV, IoT, ID Chip Cards, e-commerce, Nucleic acid amplification technology, Mobile payment, Nano technologies, Video Technologies, Bluetooth, Antibody rapid detection test methods, SMS, GPS, iiPCR technology, Telephones, Fiber optic, Face recognition technologies, Chat Bot, Ultrasonic sensors, 3D technology, IR camera technology, Modular Assembly Design, Remote consultation or monitoring technologies, TV satellite or platform, KfVirus RT-qPCR Master Mix, In Vitro Diagnostic Device methods, Electronic Bulletin Board System, Cartoon printing, Biosensor Chip, Infrared thermometers technology, Citizen Digital Certificate, Facial temperature sensor, Digital one step RT-qPCR platform, Laser guiding technology, Gene detection assay, Genome Sequence, GGH Aawrd, Genetically modified Spike protein, Electronics forms, LFIA method, Chest X-ray technology, Chemical coverall, Cell Broadcast Service, Blockchain, 4G, qPCR, TELnet protocol, Traffic Bundle Control, Microfluidic immunoassay cartridge, Machine vision, Radio Station, RT – qPCR, Machine learning, Microporous film laminate, N gene, nFOPT smart care film, Optical Radar, Triage, Oxygen Therapy, Otorhinolaryngology diagnosis, PCR (RT-PCR) technology, and RdRP.

The research has limitations, it identified the responses considered as best management practices, however, it did not evaluate their costs and effectiveness over time, which can open several opportunities for new research. Also, other research can be done with a higher number of participants in order to get more representative data. Finally, new research can be developed to compare these result against other benchmark countries such as Vietnam, Thailand, Singapore and New Zealand.

## **11. Acknowledgments**

My gratitude to:

- a) family, parents, and friends in Brazil that encouraged the author during his research in the UK;
- b) Brazilian Amazon Federal University (UFAM) to authorize my post-doctorate abroad;
- c) the team of The Manchester University, especially from MIOIR/Alliance Business School of Manchester for their wonderful structure and staff;
- d) Mr. Leo because he welcomed the author into his home in the UK, his daily ideas are nice;
- e) the teams of CopySpyder, My bib, Edraw Max, Piktochart, Libre Office, PhotoScape, International Ranking, VideoRobot, Viddyoze, Startup Blink, CMMID at the London School of Hygiene & Tropical Medicine The London, Typeform, which sites, packages, programs, reports, and statistics are useful for this and next research;
- f) the IJIER Editor and blind reviewers for their attention and contributions;
- g) all respondents that take their valuable time to answer the questionnaire, without their contribution, this article was not possible;
- h) to the authors of the papers mentioned in this article, and also to the reader, for your patience to study this long article, if you know a new solution, please send the information;
- i) all public managers, technical, nurses, doctors, professors, researchers, infectologist, drivers, cooks, janitors, donors, public and private managers, volunteers that are bravely fighting the Covid-19, God Bless You.

## 12. Appendix A – Chart 6

Organization → Solution	Type	Organization → Solution	Type
Addimmune Co. & NTU → Vaccine	Co.	Formosa Laboratories → Remdesivir	Co.
Adimmune Co. & Taiwan Government → Vaccine AdimrSC-2f (SARS-COV-2)	Co.	GeneOne → Covid-19 Nucleic Acid Diagnostic Kit	Co.
AFC → Protective Equipment and Antiviral Sprays	Co.	GeneReach → POCKIT™ Central SARS-CoV-2 (orf 1ab) Premix Reagent	Co.
Agnitio Science & Technology → BioIC SARS-CoV2 IgG/IgM Detection Kit	Co.	Genereach Biotechnology → POCKIT™ Micro Series Nucleic Acid Analyzer	Co.
AIPHAS → AIoT healthcare solution	Startup	GGM → Humidoflo HFT System & Nasal high flow oxygen therapy	Co.
Arbor Technology → Portable Temperature Screening Station	Co.	Goodideas-Studio (Howard Wu) → Mask Map	Other
Atom Health → Protective Equipment for medical services	Co.	Heroic Faith Medical Science → AI stethoscope	Co.
Bluesense Diagnostics → BlueBox	Startup	Honeywld Technology → MyGuardian	Co.
Bluesense Diagnostics → ViroTrack COVID-19 IgM / IgG	Startup	Huijia → Smart Care System	Co.
Blusense Diagnostics → Rapid Diagnostic Test	Startup	IMedCat & CC Hospital → Disinfection gateway	Co.
Brain Navi Biotechnology → Nasal Swab Robot's assistance	Startup	IMedCat → Automated Dispensing Gabinet; → Digital door sign and iMWard and iMSign; → iMRobot; → Quarantine and Polluted area disinfect Robot; → Telemedical cart in quarantine area; → Vital sign station/kiosk	Co.
BRISE → Brise AI Air Meter	Co.		
BRISE → Brise AI Guardian Angel App	Co.		
BRISE → Multi-shield facemask	Co.		
Cheetah Mobile → Cheetah Greetbot	Co.		
Cofacts Taiwan → Cofact Chatbot to combat fake news	Other		
Cold Spring Biotech Co. → Covid-19 detection reagents	Co.	ITRI → Medical grade ventilator prototype; → Nucleic Acid Detection System	Other
CSD → Alcool Prep Pad; → Color Face Mask; Anti Smog Mask; Medical Mask; Children Mask; → Wipes and Iodine Prep Pad	Co.	Instant NanoBiosensors → iNA™ COVID-19 One-Step qPCR/PCR Test Kits	Startup
Delta Electronics → Dagene G1 Automated Nucleic Acid Analysis System	Co.	Kim Forest Co. → SARS-CoV-2 Detection Kit	Co.



Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
Delta Elect. → Dagne G1 SARS-Cov-2 Test Kit	Co.	Line Corporation → Free content services	Co.
Dereckduck Industries Co. → Chemical Coverall ULTITEC series	Co.	LUFTQI → Luft Cube Portable, Filterless Air Purifier	Co.
ELECLEAN → Water to Disinfectant Technology	Startup	MedCheX → COVID-19 diagnostics from Chest X-rays.	Startup
Eternal Materials Co. Ltd → COVID-19 IgM/IgG rapid test kits	Co.	Medgen Vaccine Biologics → MVC SARS-Cov-2 qPCR Kit	Co.
FFSI & FIK → FinTechSpace Covid-19 Supporting Plan	Other	Medgen Vaccine Biologics → MVC SARS-Cov-2 Vaccine	Co.
Mediland → Hyper Light Disinfection Robot	Co.	Solomon Tech → Smart Disinfection Robot	Co.
Microlife → Thermometers (Infrared, Digital and Non-contact thermometer NC 200/TEA 2020)	Co.	Students of Linyuan Elementary School → Lego Robot	Other
MiiS → MiiS Telemedicine Solution	Co.	TABP & NHRI & IPM & NDMC → Long Zhun SARS-CoV-2 Rapid Test	Co.
Motex Healthcare Corporation → Surgical face mask with visor, Aroma fragrant face mask → Anti-Leak Diamond Shape Face Mask (TEA 2018)	Co.	Tai Doc → Covid-19 Antigen Rapid Test → Donation Non Contact Forehead Thermometer; → Non Contact Forehead Thermometer; → Pulse Oximeter	Co.
Mygopen → Fact-checking to combat fake news	Other	Taipei Mass Rapid Transit → Refuse entry into metro stations	Public
National Cheng Kung University & BAF → QurE Project for Quarantine → QR Code System for Digital Trace in University Campus	Univ.	Taipei Medical Univ & TCDC & Partners → Traffic control bundle to protect Health Workers; → Contact-Free Connected Healthcare Platform; → Healthcare Blockchain Platform	Univ.
National Chiao Tung University & Partners → AllCHECKTM Compositional Electronic Chip Platform → NCTU1 Intelligent Iot Robot	Univ.	Taiwan CIP → Revitalization plan-mobile payment feedback; → Tribal Landscape Optimization Project; → Ayoui 阿优依 " e-commerce platform; → Indigenous Peoples Committee's Relief Plan for Severe and Special Infectious Pneumonia	Other
National Chin-Yi University of Technology → Full external gas introduction cycle heat exchange health energy-saving air conditioning system.	Univ.	Taiwan Design Research Institute & partners → The MAC Ward	Other

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
NKG & partners → 3D printers to fast manufacture Protective Kits → Epidemic Prevention Video Cart → Intelligent Transportation Robot (Specimen Delivery) → Smart Epidemic Prevention Door → Smart Service Robot (Abao) → Sterilization and Disinfection Robot (Disinfection) → Temperature Measuring Smart Mirror → UVC Ultraviolet Disinfection Robot (UVC AMR)	Co.	Taiwan Gov. MOE (Ministry of Education) → Guidance for Colleges and Universities → Guidelines for University and College Preventative Measures against COVID-19 (3rd ed); → EDU Cloud website; → Guidance for Academic who return from Abroad; → Sport Department relief and revitalization measures	Public
NTU & Electronic BBS Research Society → PTT Bulletin Board System	Univ.	Taiwan Gov. & USA Government → Cohak	Public
NTU & NCTU → Fight Covid Taiwan website	Univ.	Taiwan Gov. & Mask Companies → eMask Ordering System	Public
PlexBio Co. Ltda → IntelliPlex™ SARS-CoV-2 Detection Kit	Co.	Singular Wings Medical → BeatInfo-Precaution Management System	Startup
Radica Health → ICU Remote Monitoring	Co.	Smart Ageing Tech → Jubo Long Term Care Solution	Startup
Singtex → Protective Equipment for medical services	Co.		
Taiwan Gov. Ministry of Economic Affairs (MOEA) & Partners → National Mask Team to increase production or make emergency procurement to maintain steady supplies → 1988 Relief and Revitalization HotLine → Buy More – Triple Stimulus Voucher → Expand Business Opportunities → GU Talent for training → Guaranteed Salary → Help Transition for business services → Make Up Funds for companies and families → Reduce Burden for householders and companies → Upgrade for Innovation, R&D	Public	Taiwan Gov. MoHW CECC & partners → Crucial policy for combating COVID-19 → Public Warning System (PWS) for transmissible diseases → Regulations to impose heavy penalties (fines) → Fall-Winter COVID-19 Prevention Program → Regulations concerning short-term business travelers; → Border Control → Gradual adjustment of arrival regulations to stop the epidemic to enter in Taiwan → Flu Forecast Map, National & Regional Forecast → Free Influenza Vaccines Program → National Infectious Disease Statistic System → National Laboratory Influenza Surveillance Network	Public

## Continuation of Chart 6

<b>Organization → Solution</b>	<b>Type</b>	<b>Organization → Solution</b>	<b>Type</b>
<p>Taiwan Gov. MoHW CECC &amp; partners</p> <p>→ National Health Command Center (NHCC) and Central Epidemic Command Center (CECC)</p> <p>→ Name-based Mask Distribution System 1.0, 2.0 and 3.0</p> <p>→ Compensation to quarantined individuals</p> <p>→ Home quarantine to travelers transiting</p> <p>→ Measures to person at Risk of Infection</p> <p>→ Orientations to citizens abroad</p> <p>→ Preparedness &amp; Contingency Plan in Response to Covid-19 Epidemic</p> <p>→ Rigorous isolation &amp; quarantine measures to Taiwanese returning from Wuhan</p> <p>→ Create a positive social climate for disease prevention</p> <p>→ Plans to protect citizens returning to Taiwan from high-risk regions</p> <p>Taiwan Gov. Ministry of Foreign Affair (MOFA) &amp; MOHW CECC &amp; partners</p> <p>→ 14 quarantine for foreigners with valid Taiwan Residence Certificate</p> <p>→ Measures with orientations for foreigners wishing to enter in Taiwan</p> <p>→ Temporary prohibition to foreigners enter in Taiwan</p> <p>→ 14 quarantine for transit travelers from China, HK &amp; Macau</p> <p>→ Temporary Ban for some passengers</p> <p>→ Corona disease (COVID19) outbreak Updates</p> <p>→ International Cooperation</p> <p>→ Taiwan Can Help for international support</p>	Public	<p>Taiwan Gov. MoHW CECC &amp; partners</p> <p>→ National Laboratory System</p> <p>→ National Notifiable Diseases Surveillance System (NNDSS)</p> <p>→ Taiwan Nosocomial Infections Surveillance System</p> <p>→ Promotion of Local Government Home Quarantine and Home Isolation Care Service Program</p> <p>→ Guidelines for Enterprise Planning of Business Continuity in Response to Covid19</p> <p>→ 3-tier Safety Stockpiling Framework of Personal Protective Equipment</p> <p>→ 10 strategies for medical responses and preparedness</p> <p>→ 8 primary strategies for responses and preparedness at long-term care facilities</p> <p>→ Digital Fencing Tracking System</p> <p>→ Quarantine System For Entry</p> <p>→ Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens</p> <p>→ Central and Local Government Care Centers</p> <p>→ National Health Insurance (IC Chip Card, NHI MediCloud System, etc)</p>	Public

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
Taiwan Gov. Ministry of Interior (MOI) and CECC → COVID-19 Response Guidelines: Community Management and Maintenance → Introduction of Flexible Working hours to Staff	Public	Taiwan Gov. Ministry of Transport and Communications (MOTC) & CECC & Other Ministries & Partners → Banned international ships cruise → Automobile transport Industry Relief Measures; → Aviation Industry Relief 1.0 and 2.0 Program; → Bailout 2.0 – 50 billion loan for aviation Industry → Epidemic Prevention Quarantine Hotels → Home Quarantine Persons Returning Home Transportation Program from the Airport → Hotel industry employee salary subsidy program → Infrared therm cameras in the train stations → Infrared thermometers in the Ports → Maritime Relief 1.0 and 2.0 → Orientations on Social distance, masks, food and drink in the train → Suspend group tours → Tourism Industry Relief 1.0; 2.0 and 3.0 Program	Public
Taiwan Gov. Ministry of Justice (MOJ) & Legislative & Other Ministries & Partners → Prevention measures in Correctional Institutions against covid-19 → Pharmaceutical Affairs Act → CDCA → Enforcement Regulations Governing the CECC → Foreign Trade Act; → Medical Devices Act → Regulations Governing Quarantine at Ports → Regulations Governing the Operational Procedures and Compensation for Expropriation of Manufacturing Equipment and Raw Material of Disease Prevention Supplies for Severe Pneumonia with Novel Pathogens → Special Act for Prevention, Relief and Revitalization Measures for Severe Pneumonia with Novel Pathogens; → Personal Data Protection Act	Public		
Taiwan Gov. National Communication Commission (NCC) & Partners → Deferred Payment of Communication Fee for general public and corporate users → Relax advertising time for Radio & TV Industries → Resolution for broadcasters to promote epidemic prevention and health education messages → Digital Social Innovation with Fast, Fair and Fun strategies to communicate with people → Guidance to agencies to protect personal data	Public	Taiwan Gov. Env. Protection Administration (EPA) & Other Ministries & Partners → Amend the Low Carbon Sustainable Homeland Program Implementation Guidelines Regarding Loans and Guarantees/Subsidy Regulations for Scrapping and Replacing Large Old Diesel Vehicles → Amend the Subsidy Regulations for Scrapping and Replacing Large Old Diesel Vehicles → National Disinfection Task Force to Fight COVID-19	Public
Taiwan Gov. Academia Sinica → Network to track SARS-CoV-2 variants	Public		
Taiwan Gov. Council of Agriculture (COA) & Other Ministries & Partners → Measures for the Relief and Revitalization of the Agriculture Committee			

Organization → Solution	Type	Organization → Solution	Type
Taiwan Gov. Council of Agriculture (COA) & Other Ministries & Partners → Procedures for the Relief and Revitalization of Industries and Businesses Affected by Severe Special Infectious Pneumonia by the Agriculture Committee of the Executive Yuan for operating difficulties → Reliefs for Agricultural Food → Reliefs for Animal husbandry → Reliefs for Casual; → Reliefs for Fishery → Taiwan Agricultural Products Carnival (on line shopping) → Triple Coupon + Agricultural Tour Coupon	Public	Taiwan Gov. Env. Protection Administration (EPA) & Other Ministries & Partners → Green Life for All Program → Increase subsidy in The Recycling Care Program → Loan to replace old diesel trucks to cope coronavirus → Revised the Mobile Pollution Source Air Pollutant Emissions Standards → Subsidy to replace old motorcycles with new electric motors	Public
Taiwan Gov. Ministry of Culture (MOC) & Other Ministries & Partners → Art and Literature Relief 1.0 and 2.0; → Art Fun Coupon and "Arts FUN ticket" APP; → Artsfungo platform for art stores; → Digital Art FUN Coupons; → Postponed Taipei Fashion Awards and Fashion Week; → Postponed Taipei International Book Fair and protect the rights of exhibitors and ticket buyers; → Shortening the home quarantine rules for arts and cultural groups; → Suspend and Postpone indoor or outdoor gathering activities; → Suspend Taipei International Book Fair and refund the full booth fee paid by exhibitors; → Suspend Taiwan Cultural Expo and refund the booth fees paid by the exhibitors	Public	Taiwan Gov. Ministry of Science and Technology (MOST) & Other Ministries & NCU & SmartLabs → 2020 NCKU International Virtual Forum on Covid-19 → SmartLabs Global Launch Program → Epidemic Prevention Science Research Center → Promote cooperation between domestic and foreign research institutions	Public

Continuation of Chart 6

Organization → Solution	Type	Organization → Solution	Type
Taiwan Gov. Ministry of Finance (MOF) & Other Ministries & Partners → Measures for Covid-19 Epidemic Prevention, Bailout, and Revitalization → Proactively Reducing Tariffs for Raw Materials of Medicinal Alcohol → Measures for Bank, Security and Insurance Sectors; → Financial Relief; → Flexible control of materials; → Stimulate consumption and revitalize → Tax Assistance to overcome difficulties	Public	Taiwan Media Watch & Association for Quality Journalism → Taiwan FactCheck Center	Other
		Taiwan High Speed Rail → Cancellation of no reserved train seats	Co.
		Taiwan Stanch Co. Lid → LAITEST UV Protection Medical Face Mask	Co.
		Taiwan TAITRA & Partners → Taiwan Global Anti-Covid-19 Pavillon	Other
Taiwan Gov. Ministry of Labor (MOL) & Other Ministries & Partners → Additional school subsidies for children of unemployed workers → Employment Measures for Fresh Graduates → Labor relief loan and Interest Subsidy → Measures for Enterprise; → Phoenix loan for micro entrepreneurship and repayment buffer → Real-time work plan with peace of mind → Recharge and Start Training Program (for workers); → Self-employed workers or workers without a certain employee living allowance → Sheltered workshop and visually impaired massage; → Unemployment benefit Proram	Public	TCI Corporation → QVS-96 Robot	Co.
		Tonyar Biotech Inc → ASK Covid-19 Antibody Rapid Test	Co.
		UniRing Tech Co. Ltd → MAX Robot Floor Scrubber	Co.
		VADI → VH-3000 Respiratory Humidifier and Breathing tube	Co.
		Winnoz → HAIIM	Co.

Char 6: List of Best Management Practices identified in Taiwan used to fight Covid-19

Source: Author (2020)

### 13. References

- [1] Balajee, S.A., Pasi, O.G., Etoundi, A.G.M., Rzeszotarski, P., Do, T.T., Hennessee, I., Merali, S., Alroy, K.A., Phu, T.D. and Mounts, A.W. (2017). Sustainable Model for Public Health Emergency Operations Centers for Global Settings. *Emerging Infectious Diseases*, [online] 23(Suppl 1), pp.S190–S195. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5711308/> [Accessed 24 Jul. 2020].
- [2] Balsari, S., Buckee, C. and Khanna, T. (2020). *Which Covid-19 Data Can You Trust?* [online] Harvard Business Review. Available at: <https://bit.ly/3dA1IDG> [Accessed 5 Sep. 2020].
- [3] Bell, D.M. (2004). Public Health Interventions and SARS Spread, 2003. *Emerging Infectious Diseases*, [online] 10(11), pp.1900–1906. Doi 10.3201/eid1011.040729



- [4] Bedford, J., Farrar, J., Ihekweazu, C., Kang, G., Koopmans, M. and Nkengasong, J. (2019). A new twenty-first century science for effective epidemic response. *Nature*, [online] 575(7781), pp.130–136. Available at: <https://www.nature.com/articles/s41586-019-1717-y> [Accessed 13 December 2020].
- [5] CDC (2019). *2009 H1N1 pandemic - Summary of Progress since 2009*. [online] Centers for Disease Control and Prevention. Available at: <https://www.cdc.gov/flu/pandemic-resources/h1n1-summary.htm> [Accessed 10 December 2020].
- [6] Chang, W.C. (2020). *Taiwan's Fight against COVID-19: Constitutionalism, Laws, and the Global Pandemic*. [online] Verfassungsblog. Available at: <http://bit.ly/3aQJEpD> [Accessed 20 Dec. 2020].
- [7] Cheng, T.-M. (2020). *Taiwan | Commonwealth Fund*. [online] [www.commonwealthfund.org](http://www.commonwealthfund.org). Available at: <https://www.commonwealthfund.org/international-health-policy-center/countries/taiwan>.
- [8] Chiang, H.-T. and Chang, C.-T. (2019). Introduction to and Application Analysis of Taiwan's NHI-MediCloud System. *Journal of Service Science Research*, 11(1), pp.93–115. Doi 10.1007/s12927-019-0005-6
- [9] Chuang, J.-H., Huang, A.S., Huang, W.-T., Liu, M.-T., Chou, J.-H., Chang, F.-Y. and Chiu, W.-T. (2012). Nationwide Surveillance of Influenza during the Pandemic (2009–10) and Post-Pandemic (2010–11) Periods in Taiwan. *PLoS ONE*, [online] 7(4). Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3335813/> [Accessed 24 Dec. 2020]. Doi 10.1371/journal.pone.0036120
- [10] Chung, C.S. (2017). *Taiwan's Participation is Vital to Global Influenza Pandemic Preparedness and Response*. [online] Taipei Economic and Cultural Office in Tel Aviv 駐台拉維夫台北經濟文化辦事處. Available at: [https://www.roc-taiwan.org/il\\_en/post/722.html](https://www.roc-taiwan.org/il_en/post/722.html) [Accessed 28 Dec. 2020].
- [11] Cowling, B.J., Ali, S.T., Ng, T.W.Y., Tsang, T.K., Li, J.C.M., Fong, M.W., Liao, Q., Kwan, M.Y., Lee, S.L., Chiu, S.S., Wu, J.T., Wu, P. and Leung, G.M. (2020). Impact assessment of non-pharmaceutical interventions against coronavirus disease 2019 and influenza in Hong Kong: an observational study. *The Lancet Public Health*, [online] 0(0). Doi 10.1016/S2468-2667(20)30090-6. Available at: <https://bit.ly/3b37E6Q> [Accessed 20 Apr. 2020].
- [12] Cui, Y., Zhang, Z.-F., Froines, J., Zhao, J., Wang, H., Yu, S.-Z. and Detels, R. (2003). Air pollution and case fatality of SARS in the People's Republic of China: an ecologic study. *Environmental Health*, 2(1). Doi 10.1186/1476-069X-2-15
- [13] Deep Knowledge Group (2020). *COVID-19 Regional Safety Assessment*. [online] DKV. Available at: <https://www.dkv.global/covid-19/full-report> [Accessed 22 Aug. 2020].
- [14] Dessler, G. (2004). *Management: Principles and practices for tomorrow's leaders*. Upper Saddle River, NJ: Prentice-Hall.
- [15] Flaxman, S., Mishra, S., Gandy, A. et al. (2020). Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. *Nature*. Doi 10.1038/s41586-020-2405-7
- [16] GBD 2017 SDG Collaborators (2018). Measuring progress from 1990 to 2017 and projecting attainment to 2030 of the health-related Sustainable Development Goals for 195 countries and territories: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet*, [online] 392(10159), pp.2091–2138. Doi 10.1016/s0140-6736(18)32281-5.
- [17] Golding, N. et. al. (2020). Reconstructing the global dynamics of under-ascertained COVID-19 cases and infections. *MedRxiv*. Doi 10.1101/2020.07.07.20148460

- [18] Gomes da Silva, J. (2020). Thailand Performance and Best Management Practices that saved lives against Covid-19: a comparison against ten critical countries. *International Journal for Innovation Education and Research*, 8(11), pp.119–154. Doi 10.31686/ijer.vol8.iss11.2725
- [19] Ha, B.T.T., Ngoc Quang, L., Mirzoev, T., Tai, N.T., Thai, P.Q. and Dinh, P.C. (2020). Combating the COVID-19 Epidemic: Experiences from Vietnam. *International Journal of Environmental Research and Public Health*, 17(9), p.3125.
- [20] Han, E., Chiou, S.-T., McKee, M. and Legido-Quigley, H. (2020). The resilience of Taiwan's health system to address the COVID-19 pandemic. *EClinicalMedicine*, [online] 24, p.100437. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7320260/>.
- [21] Holmes, K.V. (2003). SARS coronavirus: a new challenge for prevention and therapy. *Journal of Clinical Investigation*, 111(11), pp.1605–1609. Doi 10.1172/JCI18819
- [22] IMF (2020). *Policy Responses to COVID19*. [online] IMF. Available at: <https://bit.ly/345Ohbj> [Accessed 18 Jul. 2020].
- [23] Institute of Medicine. (2004). *Learning from SARS: Preparing for the Next Disease Outbreak: Workshop Summary*. Washington, DC: The National Academies Press. Doi 10.17226/10915.
- [24] Intermountain Healthcare (2020). *What's the difference between a pandemic, an epidemic, endemic, and an outbreak?* [online] intermountainhealthcare.org. Available at: <http://bit.ly/3mvJG8s>
- [25] La, V.-P., Pham, T.-H., Ho, M.-T., Nguyen, M.-H., P. Nguyen, K.-L., Vuong, T.-T., Nguyen, H.-K.T., Tran, T., Khuc, Q., Ho, M.-T. and Vuong, Q.-H. (2020). Policy Response, Social Media and Science Journalism for the Sustainability of the Public Health System Amid the COVID-19 Outbreak: The Vietnam Lessons. *Sustainability*, 12(7), p.2931.
- [26] Lee, W.-C. (2020). Taiwan's Experience in Pandemic Control. *Journal of the Chinese Medical Association*, [online] Publish Ahead of Print(7). Available at: <http://bit.ly/34I660h> [Accessed 24 Dec. 2020].
- [27] Lee, T.-L. (2020b). Legal preparedness as part of COVID-19 response: the first 100 days in Taiwan. *BMJ Global Health*, 5(5), <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7246107/>. Doi 10.1136/bmjgh-2020-002608
- [28] Lin, C., Braund, W.E., Auerbach, J., Chou, J.-H., Teng, J.-H., Tu, P. and Mullen, J. (2020). Policy Decisions and Use of Information Technology to Fight 2019 Novel Coronavirus Disease, Taiwan. *Emerging Infectious Diseases*, 26(7). Doi 10.3201/eid2607.200574
- [29] Lo, MC.M., Hsieh, HY. (2020). The “Societalization” of pandemic unpreparedness: lessons from Taiwan's COVID response. *Am J Cult Sociol* 8, pp. 384–404. Doi 10.1057/s41290-020-00113-y
- [30] Kan, H.-D., Chen, B.-H., Fu, C.-W., Yu, S.-Z. and Mu, L.-N. (2005). Relationship Between Ambient Air Pollution and Daily Mortality of SARS in Beijing. *Biomedical and Environmental Sciences*, [online] 18(1), pp.1–4. Available at: <https://bit.ly/2FGDcnY> [Accessed 20 Aug. 2020].
- [31] Jian, S.-W., Chen, C.-M., Lee, C.-Y. and Liu, D.-P. (2017). Real-Time Surveillance of Infectious Diseases: Taiwan's Experience. *Health Security*, 15(2), pp.144–153. Doi 10.1089/hs.2016.0107
- [32] Jian, S.-W., Cheng, H.-Y., Huang, X.-T. and Liu, D.-P. (2020). Contact tracing with digital assistance in Taiwan's COVID-19 outbreak response. *International Journal of Infectious Diseases*, 101, pp.348–352. Doi 10.1016/j.ijid.2020.09.1483

- [33] Jones, A., (2020). *How 'Overreaction' Made Vietnam A Virus Success*. [online] BBC News. Available at: <https://www.bbc.com/news/world-asia-52628283> [Accessed 3 June 2020].
- [34] MOHW (2020). *Taiwan Can Help - National Health Insurance's Contribution in Combating COVID-19*. [online] 衛生福利部中央健康保險署. Available at: <https://bit.ly/2LcvhRS>
- [35] MOHW (2020b). *Crucial Policy for Combating COVID-19*. [online] 衛生福利部. Available at: <https://covid19.mohw.gov.tw/en/mp-206.html>.
- [36] NTI, JHU and EIU (2019). *The Global Health Security Index 2019*. Nuclear Threat Initiative (NTI), Johns Hopkins Center for Health Security (JHU) and The Economist Intelligence Unit (EIU). Available at: <https://www.ghsindex.org/> [Accessed 20 feb. 2019].
- [37] NUMBEO (2020). *Health Care Index by Country 2020*. [online] [www.numbeo.com](http://www.numbeo.com). Available at: <https://bit.ly/347azcP> [Accessed 10 Jul. 2020].
- [38] OECD (2020). *OECD Policy Responses to Coronavirus (COVID-19)*. [online] [www.oecd.org](http://www.oecd.org). Available at: <https://bit.ly/3o4kuYS> [Accessed 18 Jul. 2020].
- [39] Our World in Data (2020). *Policy Responses to the Coronavirus Pandemic - Statistics and Research*. [online] Our World in Data. Available at: <https://bit.ly/2H83MXM>.
- [40] Pang, X. (2003). Evaluation of Control Measures Implemented in the Severe Acute Respiratory Syndrome Outbreak in Beijing, 2003. *JAMA*, 290(24), p.3215. Doi 10.1001/jama.290.24.3215
- [41] Petersen, E., Koopmans, M., Go, U., Hamer, D.H., Petrosillo, N., Castelli, F., Storgaard, M., Al Khalili, S. and Simonsen, L. (2020). Comparing SARS-CoV-2 with SARS-CoV and influenza pandemics. *The Lancet Infectious Diseases*, 20(9). Doi 10.1016/s1473-3099(20)30484-9
- [42] Policy (2020). *COVID-19 Policy Watch | Tracking governments' responses to the pandemic*. [online] COVID-19 Policy Watch | Tracking governments' responses to the pandemic. Available at: <https://covid19policywatch.org/policies/taiwan> [Accessed 26 Dec. 2020].
- [43] Prilutsky, D., Rogachev, B., Marks, R.S., Lobel, L. and Last, M. (2011). Classification of infectious diseases based on chemiluminescent signatures of phagocytes in whole blood. *Artificial Intelligence in Medicine*, 52(3), pp.153–163. Doi 10.1016/j.artmed.2011.04.001
- [44] PTT (2019). [問卦] 武漢疑爆發非典型肺炎冠狀病毒群聚感染? [*Question Gua*] Wuhan is suspected of a cluster infection of atypical pneumonia and coronavirus? [online] [www.ptt.cc](http://www.ptt.cc). Available at: <https://www.ptt.cc/bbs/gossiping/M.1577730263.A.177.html> [Accessed 25 Dec. 2020].
- [45] Rigby, D. (2001). Management tools and techniques: A survey. *California Management Review*, 43(2), 139-160.
- [46] Roser, M., Ritchie, H., Ortiz-Ospina, E. and Hasell, J. (2020). Coronavirus Pandemic (COVID-19). *Our World in Data*. [online] Available at: <https://bit.ly/3lWE0o9> [Accessed 25 Sep. 2020].
- [47] Summers, D.J., Cheng, D.H.-Y., Lin, P.H.-H., Barnard, D.L.T., Kvalsvig, D.A., Wilson, P.N. and Baker, P.M.G. (2020). Potential lessons from the Taiwan and New Zealand health responses to the COVID-19 pandemic. *The Lancet Regional Health – Western Pacific*, [online] 0(0). Available at: <https://bit.ly/3aHddd0> Doi 10.1016/j.lanwpc.2020.100044
- [48] Silva, J.G. da (2020a). Evolution of COVID19 new cases in 16 countries and Scenarios for Brazil using metaphorical analysis of Board, Inverted Pyramid and Papyri. *International Journal for Innovation Education and Research*, [online] 8(4), pp.560–607. Doi 10.31686/ijer.vol8.iss4.2314

- [49] Silva, J.G. da (2020b). A healthy, innovative, sustainable, transparent, and competitive methodology to identify twenty benchmark countries that saved people lives against Covid-19 during 180 days. *International Journal for Innovation Education and Research*, [online] 8(10), pp.541–577. Doi 10.31686/ijer.vol8.iss10.2710
- [50] Smith, K.F., Goldberg, M., Rosenthal, S., Carlson, L., Chen, J., Chen, C. and Ramachandran, S. (2014). Global rise in human infectious disease outbreaks. *Journal of the Royal Society, Interface*, [online] 11(101), p.20140950. Doi 10.1098/rsif.2014.0950
- [51] Start Up Blink (2020). *Global Map of Coronavirus Innovations*. [online] coronavirus.startupblink.com. Available at: <https://coronavirus.startupblink.com/>
- [52] Sutherland, J., & Canwell, D. (2004). *Key concepts in management*. New York: Palgrave MacMillan.
- [53] Svoboda, T., Henry, B., Shulman, L., Kennedy, E., Rea, E., Ng, W., Wallington, T., Yaffe, B., Gournis, E., Vicencio, E., Basrur, S. and Glazier, R.H. (2004). Public Health Measures to Control the Spread of the Severe Acute Respiratory Syndrome during the Outbreak in Toronto. *New England Journal of Medicine*, 350(23), pp.2352–2361. Doi 10.1056/NEJMoa032111
- [54] TAITRA (2020). *Taiwan Anti-COVID-19 Pavilion*. [online] Available at: <https://www.anticovid19tw.org/>.
- [55] Taiwan External Trade Development Council (2020). *A Bravery Story - A Taiwan National Machine Tool Team for Surgical Mask Production born to fight against Covid-19 outbreak*. [online] www.trade.gov.tw. Available at: <http://bit.ly/2WJGHPr> [Accessed 26 Dec. 2020].
- [56] TCDC (2012). *Influenza Pandemic Strategic Plan - Third Edition*. [online] www.cdc.gov.tw. Available at: <http://bit.ly/2WR7hGj> [Accessed 28 Dec. 2020].
- [57] TCDC (2018). *NHCC*. [online] www.cdc.gov.tw. Available at: <http://bit.ly/2zUa7SI>.
- [58] TCDC (2020). *Prevention and Control of COVID-19 in Taiwan*. [online] www.cdc.gov.tw. Available at: [https://www.cdc.gov.tw/Category/Page/0vq8rsAob\\_9HCi5GQ5jH1Q](https://www.cdc.gov.tw/Category/Page/0vq8rsAob_9HCi5GQ5jH1Q) [Accessed 25 Dec. 2020].
- [59] TCDC (2020b). *Preparedness and Contingency Planning in Response to COVID-19 Epidemic\_0411.pdf*. [online] www.cdc.gov.tw. Available at: <http://bit.ly/2KvXSS6>.
- [60] United Nations Population Fund, U. (2019). *World Population Dashboard*. [online] Unfpa.org. Available at: <https://www.unfpa.org/data/world-population-dashboard> [Accessed 3 Jul. 2020].
- [61] Van Assen, M., Van Den Berg, G., & Pietersma, P. (2009). *Key management models: The 60+models every manager needs to know*. Harlow: Prentice Hall
- [62] Zambrano-Monserrate, M.A., Ruano, M.A. and Sanchez-Alcalde, L. (2020). Indirect effects of COVID-19 on the environment. *Science of The Total Environment*, 728 (138813), pp.1–4. Doi 10.1016/j.scitotenv.2020.138813
- [63] Yeh, M.-J. and Cheng, Y. (2020). Policies Tackling the COVID-19 Pandemic: A Sociopolitical Perspective from Taiwan. *Health Security*, 18(6). Doi 10.1089/hs.2020.0095
- [64] Yen, M.-Y., Lin, Y.-E., Lee, C.-H., Ho, M.-S., Huang, F.-Y., Chang, S.-C. and Liu, Y.-C. (2011). Taiwan's traffic control bundle and the elimination of nosocomial severe acute respiratory syndrome among healthcare workers. *Journal of Hospital Infection*, 77(4), pp.332–337. Doi 10.1016/j.jhin.2010.12.002



- [65] Yen, M.-Y., Chiu, A.W.-H., Schwartz, J., King, C.-C., Lin, Y.E., Chang, S.-C., Armstrong, D. and Hsueh, P.-R. (2014). From SARS in 2003 to H1N1 in 2009: lessons learned from Taiwan in preparation for the next pandemic. *Journal of Hospital Infection*, 87(4), pp.185–193. Doi 10.1016/j.jhin.2014.05.005
- [66] Watts, J. (2003). Report details lessons from SARS outbreak. *The Lancet*, 362 (9391), p.1207. Doi 10.1016/s0140-6736(03)14561-8.
- [67] Wang, C.J., Ng, C.Y. and Brook, R.H. (2020). Response to COVID-19 in Taiwan. *JAMA*, 323(14). doi:10.1001/jama.2020.3151
- [68] WHO (2005). *WHO checklist for influenza pandemic preparedness planning*. [online] Available at: <https://bit.ly/2J8R0Jw> [Accessed 20 Dec. 2020].
- [69] WHO (2012). WHO | SARS (Severe Acute Respiratory Syndrome). [online] World Health Organization. Available at: <https://www.who.int/ith/diseases/sars/en/> [Accessed 20 Aug. 2020].
- [70] WHO (2016). *An R&D Blueprint for action to prevent epidemics funding & coordination models for preparedness and response*. [online] World Health Organization. Available at: [https://www.who.int/blueprint/what/improving-coordination/workstream\\_5\\_document\\_on\\_financing.pdf?ua=1](https://www.who.int/blueprint/what/improving-coordination/workstream_5_document_on_financing.pdf?ua=1). [Accessed 20 Dec. 2020].
- [71] WHO (2017). *Pandemic Influenza Risk Management - A WHO guide to inform & harmonize national & international pandemic preparedness and response*. [online] World Health Organization. Available at: <http://bit.ly/3h86H01> [Accessed 20 Dec. 2020].
- [72] WHO (2018). *Building capacity for pandemic response A checklist for pandemic influenza risk and impact management 2018 UPDATE G L O B A L I N F L U E N Z A P R O G R A M M E*. [online] World Health Organization. Available at: <https://bit.ly/3ht6AML> [Accessed 20 Dec. 2020].
- [73] WHO (2020). *Naming the coronavirus disease (COVID-19) and the virus that causes it*. [online] World Health Organization. Available at: <https://bit.ly/30xIpWt> [Accessed 18 Aug. 2020].
- [74] WHO (2020b). *COVID-19 Strategic Preparedness and Response Plan - Operational planning guidance to support country preparedness and response*. [online] World Health Organization. Available at: <http://bit.ly/3aNPQB> [Accessed 21 Dec. 2020].
- [75] WHO (2020c). *Overview of Public Health and Social Measures in the context of COVID-19*. [online] [www.who.int](http://www.who.int). Available at: <https://bit.ly/2T4fkxC> [Accessed 22 Sep. 2020].
- [76] Worldometer (2020). *Coronavirus Toll Update: Cases & Deaths by Country of Wuhan, China Virus - Worldometer*. [online] [Worldometers.info](http://Worldometers.info). Available at: <https://www.worldometers.info/coronavirus/>
- [77] Wu, T.-Y., Majeed, A. and Kuo, K.N. (2010). An overview of the healthcare system in Taiwan. *London journal of primary care*, [online] 3(2), pp.115–9. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3960712/> [Accessed 17 Oct. 2019]. Doi 10.1080/17571472.2010.11493315

### Copyright Disclaimer

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>).

# **Project Model Canvas' Contributions to the Project-Based Learning Method**

**Francisca Janaina Dantas Galvão Ozório**

IFCE/Maranguape – Federal Institute of Education, Science and Technology of Ceará, Brazil

ORCID: <https://orcid.org/0000-0001-8826-8578>

E-mail: [jana.ozorio@hotmail.com](mailto:jana.ozorio@hotmail.com)

**Petrônio Cavalcante**

ORCID: <https://orcid.org/0000-0002-4732-7014>

UNILAB – University of International Integration of Afro-Brazilian Lusophony, Brazil

E-mail: [petronioprofessor3@gmail.com](mailto:petronioprofessor3@gmail.com)

**Ana Lucia Ferreira Pitombeira**

ORCID: <https://orcid.org/0000-0000-0002-0295-4663>

IFCE/Maranguape – Federal Institute of Education, Science and Technology of Ceará, Brazil

E-mail: [analufamaro@gmail.com](mailto:analufamaro@gmail.com)

**Geraldo Venceslau de Lima Junior**

ORCID: <https://orcid.org/0000-0002-9522-9718>

IFCE/Tabuleiro do Norte – Federal Institute of Education, Science and Technology of Ceará, Brazil

E-mail: [geraldovenceslau@gmail.com](mailto:geraldovenceslau@gmail.com)

**Sinara Mota Neves de Almeida**

ORCID: <https://orcid.org/0000-0002-8183-1636>

UNILAB – University of International Integration of Afro-Brazilian Lusophony, Brazil

E-mail: [sinaramota@unilab.edu.br](mailto:sinaramota@unilab.edu.br)

**Emanoel Rodrigues Almeida**

ORCID: <https://orcid.org/0000-0001-9787-0851>

IFCE/Maranguape – Federal Institute of Education, Science and Technology of Ceará, Brazil

E-mail: [emanoel.almeida@ifce.edu.br](mailto:emanoel.almeida@ifce.edu.br)

**Andrea Moura da Costa Souza**

ORCID: <https://orcid.org/0000-0003-1059-0756>

IFCE/Paracuru – Federal Institute of Education, Science and Technology of Ceará, Brazil

E-mail: [andrea.souza@ifce.edu.br](mailto:andrea.souza@ifce.edu.br)



**Igor de Moraes Paim**ORCID: <https://orcid.org/0000-0000-0001-9968-2213>

IFCE/Maranguape – Federal Institute of Education, Science and Technology of Ceará, Brazil

E-mail: [igormoraes@ifce.edu.br](mailto:igormoraes@ifce.edu.br)

## Abstract

*The present study has as its main objective to contribute to the Project-Based Learning (PBL) Method, in face-to-face and/or remote education, with the help of Project Model Canvas (PMC), a project management tool; as secondary objective, it intends to become acquainted with PMC, as one of the existing Project Management methods, and understand PBL's relevance for face-to-face or remote education. It is a qualitative review of literature; two digital platforms, Scientific Electronic Library Online (sciELO) and Google Scholar, were searched for papers in the field of Education that address PMC and PBL between 2013 to 2019. Results show that the integrating PMC into PBL would make project planning and management more collaborative and fluid, facilitating the delivery of the end product, thus promoting significant and integral learning of the subjects involved. At the end of the study, it is concluded that PBL may be better more efficiently implemented when combined with the PMC, a practical model for the creation and management of short, medium and long-term projects. The combined use of the two methodologies fosters the construction of meaningful, self-directed student knowledge, favoring the development of their cognitive and socio-emotional skills.*

**Keywords:** Project Model Canvas; Project-Based Learning; project management; meaningful learning.

## 1. Introduction

In the last two decades, the world has undergone changes in all sectors, namely in politics, economy, health, culture and education. Therefore, the discussion on the development of basic competencies and skills that help students improve their ability to continue learning grows not only in the work market, but also in the education sector.

This is due to the process of globalization and the speeding of information and communication, made possible by digital technologies, which increasingly require an education in which everyone learns to “to know, to build their life projects and to live with others” (MORAN, 2015, p. 15). However, students often claim that classes are “demotivating”; teachers also complain of their pupils’ passive attitude. In face of with this new reality, curriculum organization, as well as methodologies, times and spaces, need to be reviewed.

In addition, the pandemic caused by the highly contagious COVID-19 has greatly impacted schools, which, alongside their teachers, had to change their modes of operation with a view to continuing their pedagogical work by their students.

In this sense, the importance of improving and expanding the combined use of innovative methodologies and digital technologies can positively impact student learning in distance and remote education (PAIM, 2016).

It is possible, for example, to employ the Project-Based Learning (PBL) Method remotely. However, this method is riddled with doubts, and teachers are unsure as to how to conduct it (BENDER, 2014). Faced with this difficulty, it is suggested the use of accessory project creation and management methods, either in face-to-face or distance learning, such as Project Model Canvas (PMC) (FINOCCHIO JUNIOR, 2013). In this context, we aim to answer the following central question: How can PMC, a project-management tool, contribute to the PBL Method in face-to-face and/or remote education?

With the above starting points in mind, the present research has the following objectives: to contribute to the face-to-face and/or remote use of the PBL Method with the help of PMC; to become acquainted with PMC, as one of the existing Project Management methods; to understand the PML Method's relevance to face-to-face or remote education.

Methodologically, we opted for a qualitative approach (MINAYO, 2012) in order to conduct a review of literature (LIBÂNEO, 1990; FAGUNDES, 1999; PEPERT 1997; GIL 2008; SALDANHA, 2013; CIRILO, LEÃO and PORTO 2017, CARBONELL, 2017). In addition to these authors, in order meet our objectives, we conducted a survey on the digital platforms *Scientific Electronic Library Online* (sciELO) and *Google Scholar*, in search for papers in the area of Education addressing PMC and PBL, specifically between 2013 and 2019.

This allowed us to understand how a project management tool such as PMC can contribute to the PBL Method in face-to-face or remote education, and thus provide the development of the ideas and skills so necessary for the twenty-first century, namely: criticality, creativity, collaborativity, citizenship, character and communicability (PAIM, 2016).

After having introduced the issue at hand and our objectives in the above, in section 2, the methodology adopted is outlined; sections 3 and 4 discuss PBL and PMC, respectively, as well as the latter's contributions to project management and applicability in face-to-face and/or remote education. Then, in section 5, we present our findings concerning PMC's applicability to PBL, and, in section 6, our final remarks.

## **2. Methodology**

This study follows a qualitative approach (MINAYO, 2012), and conducts a review of literature, the principle of which is to gather, organize, and systematize publications in journals, books, among others; after the data has been collected, it is possible to undertake a critical-reflective evaluation.

According to Gil (2008), a review of literature that dives deep into its theme and with an ethical, moral, social and political commitment allows researchers to obtain a panoramic view on the subject under investigation, as this type of study allows us to know what the authors published on PBL, PMC and their contributions to education.

To this end, we first conducted a survey of papers published on the digital platforms *SciELO* and *Google Scholar*, using the keywords "Project Model Canvas (PMC)" and "Project-Based Learning (PBL)", specifically between 2012 and 2020, in Education journals.

In total, we found 04 papers on the theme. This number was reached after a selection, in which titles, abstracts, keywords and final remarks were checked. We understand that this was necessary, as some papers' titles, for example, were not in line with our objectives in this research.

### **3 Project-Based Learning: some theoretical considerations**

PBL is a project-based learning method. One of its premises is the importance of students' prior knowledge. Fagundes, Sato and Maçada (1999, p. 5) explain that "learning by projects" refers necessarily to the formulation of questions by the author of the project and by the subject who will build knowledge. The authors claim that we start from the principle that the student is never a "tabula rasa", that is, they were capable of thinking before. It is from their previous knowledge that learners will move, interact with the unknown, or with new situations, to appropriate specific knowledge – whether in science, arts, traditional culture or culture in transformation.

Men and women, throughout their existence, have always had the need to create projects, whether on a personal, family, professional or social level, among others. Therefore, it can be stated that the undertaking of projects is inherent to the human being. Creating a project is equivalent to drawing up a plan to make a certain dream come true. However, most of the time, people are not known to systematize their dreams, especially their personal projects.

In this scenario, from a systematized perspective, we will present PBL, which is an innovative method in education that provides numerous strategies that are beneficial to students' learning process. According to Cyril, Leão and Porto (2017), the term was coined in Canada, in 1960, at McMaster University, specifically in the School of Medicine.

With PBL, students learn to be autonomous thinking agents, and become creators of their own paths in the learning process, developing it in groups to conduct research, creating projects that reflect their knowledge through problems or questions posed by teachers in order to instigate and stimulate them to find solutions. However, students participate in the entire decision-making process. Saldanha (2013, p. 5) states that, in developing PBL, the pedagogical strategy is to present students with situations that are meaningful and contextualized in their reality, identifying problems and seeking solutions to solve them; for Saldanha, students and teachers cooperate, and share authorship.

In this sense, according to the author, the work plan is taken jointly among teachers and students. That is, in the PBL Method, students become partners of their teachers, thus characterizing a heterarchical relationship, in which these subjects are builders of knowledge. The choice of the theme is based on the concerns, questions, doubts and uncertainties of those involved in the process that take into account the context in which the students are inserted.

In this perspective, according to Papert (1997), in PBL, unlike traditional teaching, the teacher's role is that of mediator, advisor, facilitator and collaborator. That is, teachers open ways for students' discoveries as political and social subjects, who take part in society and in their own learning processes. According to the same author, in this method, students are able to build new knowledge at any time and situation of their lives.

Similarly, Libâneo (1990) understands that the teacher needs to propose students new challenges and promote, for them, opportunities to create and discover new learning and new projects. In order to do so, it is necessary to promote uninterrupted, unfragmented work, and, above all, take students' prior knowledge into account

PBL is relevant in present times, as it points to the construction of integrated knowledge, made possible by more innovative approaches that better meet the social, cultural and educational demands of the Twenty-First Century.

According to the Brazilian Curricular Guidelines (DCNs) for Basic Education, the school needs to be reinvented; it must be capable of producing inventive, participatory, cooperative subjects, prepared for insertion in diverse social, political, cultural and work environments, while capable of intervening in and problematizing ways of production and living (Brazil, 2013, p.16).

In this sense, Carbornell (2016, p.201) points that the educational perspective of work projects is a new integral conception of education, and a way of thinking and being in school that breaks with plastered curricula and with the obsession for result-driven activities. Learning focuses on the construction of significant knowledge, consolidated and made possible by projects that stimulate curiosity, dialogue, cooperation, among other cognitive and socio-emotional skills, envisioning the integral formation of the subject.

According to the Buck Institute for Education (BIE), PBL helps students develop problem-solving skills needed today, and it defines PBL as a systematic method of teaching that involves students in acquiring knowledge and skills through an extensive research process, structured around complex and authentic issues and carefully planned products and tasks. This definition covers a spectrum ranging from brief one or two-week projects based on a single subject in the classroom, to interdisciplinary projects throughout the school year, and involving community and adult participation outside the school (BIE, 2008, p.18).

For this reason, it is possible that individual or group works reach varied findings and considerations, which makes this type of method interesting, since in an exhibition and presentation of works in the classroom or in any other space, for example, information can be changed, added or supplemented. After all, this is one of PBL's purposes: integrating and respecting all forms of knowledge, both similar and divergent, as well as instigating the development of skills. Therefore, with this attitude, learning and skills will be developed. In this sense, based on the contributions brought by the authors mentioned here, PBL is believed to be one of the existing methods in education that can help students learn in face-to-face and/or remote education, especially at a time when the world faces the COVID-19 pandemic, when students need to manage their studies.

#### **4. Project Model Canvas (PMC)**

PMC is a useful project management methodology for environments that wish to improve their planning capacity, but that are characterized by innovation, high business dynamics and project simultaneity, to which rigid and plastered solutions do not apply (PROJECT BUILDER, 2013, p. 5).

However, the project management theme is not new, existing since the Cold War (1947-1991), when it was used in military actions and, later, after improvements, was incorporated into large companies. Currently, however, it is accessible to small and medium-sized enterprises.

According to Ferreira and Ota (2019, p. 243), project management can be carried out through the application and integration of 47 processes, strategically grouped into five groups of processes: initiation; planning; execution; monitoring and control, and closure. The authors also state that project management requires, in addition to planning, the need to evaluate whether the product or service allows this form of management.

That said, the Canvas methodology may be considered a visual management model that uses drawings to represent ideas; a project plan and the mental plan one has of it may be sketched, and its links and interrelations are exposed on a large sheet (A1) with post-it notes that are placed in its 13 frames, which, in summary, answer the questions: Why, What, Who, How, When and How Much. These questions are essential, as they “are the ones that define your project. They facilitate understanding, execution, control and evaluation by following an order that helps in the organization of its conception” (PROJECT BUILDER, p. 14), as we can see in the following figure:



Figure 1. Por quê? (Why?), O quê? (What?), Quem? (Who?). Como? (How?), Quando e quanto? (When and How Much?) Source: <https://www.gp4us.com.br/project-model-canvas/>, accessed Dec. 21, 2020.

Such questions direct the plan. Thus, everyone can contribute collaboratively in its elaboration. However, it is important to emphasize that at least one of the members must have basic knowledge on Project Management (FERREIRA and OTA, 2019).

Another relevant factor regarding Canvas is that PMC contemplates responding to specifications about the project manager (PM) and pitch (MEDEIROS and; SILVA, 2017, *apud* FERREIRA and OTA, 2019, p. 244). Regarding pitch, this is the first part of the Canvas to be filled, and in it you should summarize your project in one sentence.

In order to build the PMC, in addition to the pitch, there are paths to follow, as described below:

in the **justification** section, the problems the organization is facing, and needs not being met must be outlined; in the **S.M.A.R.T. goals**, the project's goals must be stated so they are Specific, Measurable, Attainable, Realistic and Time-Bound; the **benefits** section specifies what your company will gain after a given project is implemented; the **product** corresponds to the project's final result, which may also be a service; the **requirements**

define the product or service's quality so that it is of value for the client; under **stakeholders**, all external factors that may affect the project must be identified; under **team**, all those responsible for the project's deliveries must be listed; under **premises**, all suppositions taken as certain are listed; under **delivery groups**, all tangible, measurable and concrete components which will be generated by the project must be specified; under **restrictions**, all limitations to the project must be described; under **risks**, all relevant future and uncertain events are considered; the **timeline** defines when deliveries shall take place; the **costs** section specifies how much will be paid for the project's conclusion. (FERREIRA and OTA, 2019, p. 246.)

The essential path for the elaboration of the PMC is visibly described above. However, it is necessary to emphasize that, in addition to filling in the slots relating to the key concepts, it is necessary to make sure that there is coherence among them, as well as an association between the filled areas. However, it is worth noting that Canvas may also be presented digitally: "with a television or overhead projector, where the Canvas URL may be projected, all members of your team will be able to view the project plan together" (PROJECT BUILDER, 2017, p. 8).

## **5. Results and discussion: PMC's contributions to PBL**

In order for the proposed projects to really provide the integral formation of the student, they must be very well planned and followed so that they produce really significant knowledge.

According to the BIE (2008), PBL contributes to the development of skills. However, the need of good planning so as to achieve the objectives proposed by the project, be it short or long-term, is emphasized.

The project needs to be well planned and supervised through the monitoring of actions, enabling their control and assessment, so that the end product meets the objectives initially outlined.

In this sense, we propose PMC as support for PBL, as one of the latter's shortcomings is actions management. According to Bender (2014) and El Al Franks and Franco (2020, p. 319), the common aspects of project-based learning are: generating students' interest by means of a guiding and highly motivating issue (anchor), making students' experiences meaningful by cooperative work, constant feedback and review, investigating and innovating based on the established driving issue, providing constant room for reflection, a continuous investigative process, public presentation of the results, and active participation of students, giving them 'voice' throughout the course.

Following this line of reasoning, we signal the relevance of establishing significant actions so that projects do not culminate in improvisation and disconnected actions.

Starting from the need for a good monitoring of actions for PBL to succeed, PMC is an innovative possibility for project monitoring and management, as it presents a full view of the entire plan on a single page, facilitating the management of project actions as a whole. In this methodology, therefore, the participants, the subjects involved in the project, fill out a CANVAS placing post-it notes on 13 frames that define: why, what, who, how, when and how much. These questions define the planning of the project to be developed in PBL.



Thus, PMC can contribute to PBL in the sense that this methodology aims to align and continuously monitor work flows in order to ensure the development of project activities, compliance with deadlines and effective delivery of the end product.

This methodology enables the management of actions for the delivery of the product, as one of PBL's shortcomings is actions monitoring, which leads to their delay, and consequently in the non-delivery of a product due to lack of good project management.

In this sense, Canvas prioritizes project management by assigning responsibilities to all those involved, defining the roles of team members and avoiding conflict. To this end, efficient communication between stakeholders is needed, thus avoiding the spread of mistaken ideas and concepts regarding the project's activities and results. Therefore, it is important to establish a periodicity of communication between members stimulating the participation and involvement of all.

Thus, there is a consensus among the authors (BEHRENS, 2014; BENDER, 2014; HERNÁNDEZ and VENTURA, 1998; ZABALA, 2002) that the active participation of students drives them to be responsible for their learning, and to commit to the activities that will be developed at each stage; when they are instigated to seek a real solution to a real problem, motivation tends to increase.

Results show that integrating PMC into PBL would make project planning and management more collaborative and fluid, facilitating the delivery of the end product, thus promoting significant and integral learning of the subjects involved.

## **6. Final Remarks**

The COVID-19 pandemic has profoundly impacted how teaching institutions around the globe organize themselves, how they act, their time management and pedagogical strategies; this invariably entailed modifications or adaptations to teachers' pedagogical work in remote education. The massive use of digital educational technologies (Virtual Learning Environments, softwares for videoconferencing or evaluating, interactive simulators, educational games, among others) have established themselves as essential channels and bridges between teachers and students. However, the use of technology alone does not guarantee quality teaching; it must be effectively allied with educational methodologies that place student at the center of the teaching and learning process. Thus, active methods such as PBL may greatly foster students' meaningful and self-directed knowledge construction, in addition to favoring the development of their cognitive and socio-emotional skills. At the end of this study, it is concluded that PBL may be more effectively implemented and organized, when combined with the PMC, a practical model for the creation and management of short, medium and long-term projects. PMC is, therefore, a powerful accessory technique for materializing clearly measurable results, focused on palpable "deliveries", deeply adaptive to all logic, to operational mechanics, to the principles and teleology of project pedagogy and to PBL itself. It should be noted that, in the midst of the various complex challenges in remote education, teachers, with their expertise and diverse knowledge and skills, are key elements to ensure the overall quality of teaching, and to offer a set of possibilities and opportunities for learning experiences through an expanded and improved didactic menu of methodologies and technologies.

## 7. References

- A. Zabala, Enfoque globalizador e pensamento complexo: uma proposta para o currículo escolar. Artmed, Porto Alegre, 2002.
- A.C. Gil, Métodos e técnicas de pesquisa social, 6th ed., Atlas, São Paulo, 2008.
- Brasil, Ministério da Educação, Secretaria de Educação Básica, Diretoria de Currículos e Educação Integral. Diretrizes Curriculares Nacionais Gerais da Educação Básica, Brasília, 2013.
- Buck Institute for Education, Aprendizagem baseada em projetos: guia para professores de ensino fundamental e médio. 2nd ed, Artmed, Porto Alegre, 2008.
- F. Franks, E. Keller-Franco, “Aprendizagem baseada em projetos: a concepção de docentes”, Revista eletrônica Científica Ensino Interdisciplinar, vol. 6, n. 17, Mossoró, 2020.
- F. Hernández, M. Ventura, A organização do currículo por projetos de trabalho, Artes Médicas, Porto Alegre, 1998.
- I.M. Paim, Os impactos do enriquecimento escolar e da estimulação da memória operacional sobre o desenvolvimento cognitivo e moral de alunos do ensino médio. Tese (Doutorado em Educação), Marília, Programa de Pós-graduação em Educação da Faculdade de Filosofia e Ciências, Universidade Estadual Paulista “Júlio de Mesquita Filho” (UNESP), 2016.
- J. Carbonell, Pedagogias do século XXI: bases para a inovação educativa, Penso, Porto Alegre, 2016.
- J. Finocchio Junior, Project Model Canvas: gerenciamento de projetos sem burocracia, Elsevier, Rio de Janeiro, 2013.
- J. Morán, “Mudando a educação com metodologias ativas”, in C. A. de Souza e O. E. Torres (eds), Convergências Midiáticas, Educação e Cidadania: aproximações jovens (Coleção Mídias Contemporâneas, vol. II, UEPG Ponta Grossa, 2015.
- J.C. Libâneo, Democratização da escola pública. A pedagogia crítico-social dos conteúdos, Loyola, São Paulo, 1990.
- L.D.C. Fagundes, L.S Sato, D.L. Maçada. Projeto? O que é? Como se faz. Aprendizizes do Futuro: as inovações começaram! Ministério da Educação, 1999.
- M.A. Behrens. “Metodologia de Projetos: aprender e ensinar para a produção do conhecimento numa visão complexa”, in P.L. Torres (ed.), Complexidade: redes e conexões na produção do conhecimento, SENAR-PR, Curitiba, 2014. Available at <https://www.agrinho.com.br/material-professor/redes-conexoes-na-producao-do-conhecimento>, accessed Dec. 21, 2020.
- M.C.D.S. Minayo, “Pesquisa Social: Teoria, Metodologia e Criatividade” Vozes, Petrópolis, 2012.
- M.S.S. Saldanha, “As TICs nos projetos de aprendizagem: uma possibilidade de reencantamento do aprendizado na EJA”, In Os desafios da Escola pública paranaense na perspectiva do professor PDE: Produções Didático-Pedagógicas (Cadernos PDE, vol. II). Curitiba, Governo do Estado do Paraná, Secretaria de Educação, 2013. Available at [http://www.diaadiaeducacao.pr.gov.br/portals/cadernospde/pdebusca/producoes\\_pde/2013/2013\\_ufpr\\_gestao\\_pdp\\_maria\\_sueli\\_sierra\\_saldanha\\_violin.pdf](http://www.diaadiaeducacao.pr.gov.br/portals/cadernospde/pdebusca/producoes_pde/2013/2013_ufpr_gestao_pdp_maria_sueli_sierra_saldanha_violin.pdf), accessed Dec. 22, 2020.

Project Builder, Guia definitivo do Project Model Canvas, 2017. Available at <https://www.projectbuilder.com.br/Downloads/Guida-Definitivo-do-Project-Model-Canvas.pdf>, accessed Dec. 22, 2020.

R.D.P. Cirilo, M. Leão, M. das G. Porto, “Proposta de integração entre a Flexquest e a aprendizagem baseada em projetos”, In: Enseñanza de las ciencias: revista de investigación y experiencias didácticas, (Special issue), 2017, pp. 1753-1758. Available at [https://ddd.uab.cat/pub/edlc/edlc\\_a2017nEXTRA/69\\_-\\_INTEGRACAO\\_ENTRE\\_A\\_FLEXQUEST\\_E\\_A\\_APRENDIZAGEM\\_BASEADA\\_EM\\_PROJETOS\\_NOS\\_CURSOS\\_DE\\_ENGENHARIA.pdf](https://ddd.uab.cat/pub/edlc/edlc_a2017nEXTRA/69_-_INTEGRACAO_ENTRE_A_FLEXQUEST_E_A_APRENDIZAGEM_BASEADA_EM_PROJETOS_NOS_CURSOS_DE_ENGENHARIA.pdf), accessed Dec. 21, 2020.

S. Papert. A família em rede: Ultrapassando a barreira digital entre gerações, Relógio D'Água, Lisboa, 1997.

T.C. Ferreira, M.A. Ota, “Contribuições do *Project Model Canvas* no Gerenciamento de Cursos Online: do planejamento às etapas de execução”, In A. R. L. da Silva (ed.), Experiências significativas para a educação à distância, Atena, Ponta Grossa, 2019, pp. 241-252, Available at <https://www.atenaeditora.com.br/wp-content/uploads/2019/04/E-book-Experiências-Significativas-para-a-Educação-a-Distância.pdf>, accessed Dec. 21, 2020.

W.N. Bender, Aprendizagem baseada em projetos: educação diferenciada para o século XXI, Penso, Porto Alegre, 2014.

#### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

## ***Pereskia aculeata* vibrational model by Raman characterization and DFT method**

**Quesle da Silva Martins**

Departamento de Física, Universidade Federal de Rondônia, Ji-Paraná, R. Rio Amazonas, 351 - Jardim dos Migrantes, Ji-Paraná - RO, 76900-726.

ORCID: <https://orcid.org/0000-0002-1315-2164>

Email: [quesle@fisica.ufmt.br](mailto:quesle@fisica.ufmt.br)

**Natali Felix Arinos**

Instituto de Física, Universidade Federal de Mato Grosso, Cuiabá, Av. Fernando Correa da Costa, 2.367 – Boa Esperança, 78060-900, Mato Grosso.

ORCID: <https://orcid.org/0000-0003-4732-7759>

Email: [talifelix@fisica.ufmt.br](mailto:talifelix@fisica.ufmt.br)

**Cristian Aguirre Tellez**

Instituto de Física, Universidade Federal de Mato Grosso, Cuiabá, Av. Fernando Correa da Costa, 2.367 – Boa Esperança, 78060-900, Mato Grosso.

ORCID: <https://orcid.org/0000-0001-8064-6351>

Email: [cristian@fisica.ufmt.br](mailto:cristian@fisica.ufmt.br)

**Jorge Luiz Brito de Faria**

Instituto de Física, Universidade Federal de Mato Grosso, Cuiabá, Av. Fernando Correa da Costa, 2.367 – Boa Esperança, 78060-900, Mato Grosso.

ORCID: <https://orcid.org/0000-0002-7066-6823>

Email: [hulk@fisica.ufmt.br](mailto:hulk@fisica.ufmt.br)

### **Abstract**

*Raman scattering was used to obtain vibrational modes in a Pereskia aculeata sample. The obtained spectrum was compared with quercetin's theoretical spectra, kaempferol, isorhamnetin, rutinose, caffeic, and tartaric acid, generated from the density functional theory (DFT) method, which used structures of the known composition present in the sample. Among the main compounds, phenolic acids and flavonoids are mentioned. Vibrational signatures, designated as CO and CH group modes, are abundant and bands in the region between 800 and 1800 cm<sup>-1</sup>. This showed that the theoretical and experimental results had good correspondence between the flavonoids. Statistical observations of correlation and principal component analysis (PCA) were used, which helped in the process of correlation between sample and data obtained. Theoretical spectra have been corrected by a single scale factor of 0.961, and vibrational contributions by the molecular group were via VEDA software.*

**Keywords:** Raman spectrum; DFT method; Ora-Pro-Nóbis; phenolic; flavonoids;

### **1. Introduction**

The United Nations (UN) presented data on population projections, and contrary to what was previously

projected, the world population is unlikely to stop growing in this century. This makes a significant increase in agricultural demand for the entire world population, inevitable to 2100 (Alstom et al., 2009; Godfray et al., 2010; Gerland et al., 2014; DESA, 2015; Rakimzhan et al., 2019). In this perspective, alternative solutions are proposed every day to minimize the impact of increasing food consumption demand. Among these alternatives, we can mention that functional foods stand out in guaranteeing nutrition because they are rich in phenolic and flavonoid compounds necessary in the human diet (Ozkan et al. 2007; Siger et al. 2008). *Pereskia aculeata*, known as Ora-Pro-Nóbis (OPN), has been indicate in recent years (Calixto et al. 2012; Pinto et al. 2015; Machado et al., 2015; Silva, 2017; Vieira et al, 2019), precisely because it contains such characteristics in food terms shown in the recent study on the existence of phenolic acids and flavonoids. Studies have shown that quercetin, isorhamnetin and kaempferol are described as the main aglycones in OPN fruits and peels. Also, references point to caffeic acid as the main phenolic constituent of the plant extract and the quercetin-3-*O*-rutinoside and isorhamnetin-3-*O*-rutinoside flavonoids (Gonçalves et al., 2015; Ferreres et al., 2017; Garcia et al. 2019; Tania, 2020). Given the potential of applications and recent studies in the identification of plant compounds, this work becomes a pioneer when carrying out an investigation by dispersive Raman spectroscopy (RS) with a plant sample, crossing information from experimental data with theoretical data obtained from density functional theory (DFT) calculations. The RS has been chosen because it is considered a specific technique capable of assisting in the plants and organic characterization process (Schulz, 2007; Gierlinger, 2007; Rakimzhan et al., 2019) and quickly obtaining information without expensive handling procedures. The computational method (DFT method) chosen is one of the most used methods to treat molecular structures' conformational and vibrational nature (Lu et al. 2013; Ramya et al., 2013; Komjati et al., 2016; Teixeira et al., 2020; Erdogan et al., 2020). The caffeic and tartaric acid, quercetin, isorhamnetin, kaempferol and rutinose molecules were optimized in a Gaussian 03 package (Figure 1). The B3LYP Functional and 6-31G (d,p) base set has been chosen for this step. Because of an overestimated spectrum set, the calculated frequencies were adjusted by scale factor (Nist, 2020) of 0.961. Maximum energy parameters of contributions by molecular groups and the classification of vibrations collected via VEDA software are also given.

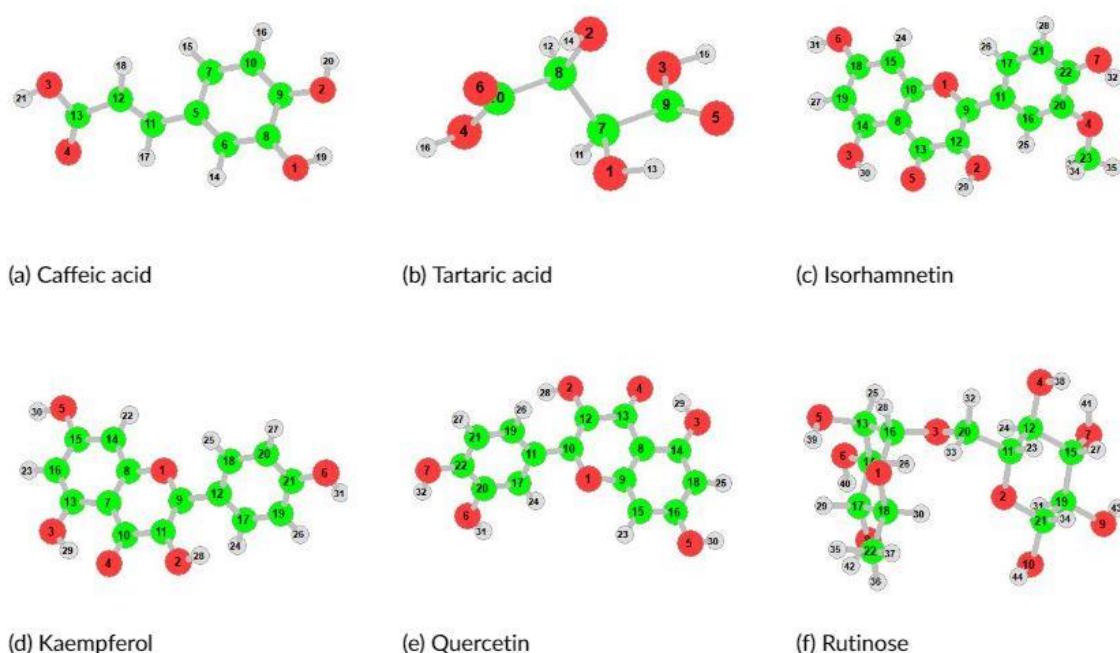


Figure 1. Molecules optimized in Gaussian by B3LYP functional and 6-31G(d,p) base set. Phenolic acids: a) Caffeic; and b) Tartaric. The c) Isorhamnetin; d) Kaempferol and e) Quercetin flavonoids. The acids a) e b) are an isolated form of Caftaric acid. Em c, d, and e, molecules isolated from Isorhamnetin-3-*O*-

rutinoside and Quercetin-3-*O*-rutinoside respectively. Em f) Rutinose, a disaccharide. In red, green, and gray, are oxygen, carbon and hydrogen respectively.

## 2. Material and Method

### 2.1 Material

The *Pereskia aculeata*, popularly known as Ora-Pro-Nóbis (OPN), is a type of Brazilian cactus. Its leaves are a great source of protein, making it superior among other vegetables, in addition to presenting basic levels of minerals, dietary fiber, vitamins, and folic acid (Souza et al., 2016; Garcia et al., 2019). This study, where a commercial brand was randomly chosen, in which a kind of organic flour made from dried OPN leaves was purchased. The sample was kept in a dry and moisture-free place and was not subjected to any RS measurement preparation.

### 2.2 Raman scattering

In the Raman scattering (Raman, 1929; Kalasinsky et al., 2007; Hui et al., 2019) of this study, a conventional Horiba Labram 800HR spectrometer, spectral at 80 to 4000  $\text{cm}^{-1}$  range, single 633 nm laser was used. The Raman spectra were obtained at separate intervals of 80-1800  $\text{cm}^{-1}$  and between 1800 and 3600  $\text{cm}^{-1}$ , with a resolution of 2  $\text{cm}^{-1}$ , the microscope is confocally coupled to an 800 mm focal length spectrograph, equipped with two selectable grids. The spectra were collected at room temperature in pure samples.

### 2.3 Computational method

The computational calculations were performed based on the functional density theory (DFT) method, whose molecular geometries were optimized with functional B3LYP and base set 6-31G(d,p) (Ditchfield, 1971; Henne, 1972; Petersson, 1991; Rassolov et al., 1998; Rassolov et al., 2001), in Gaussian Package 03 (Gaussian, 2003). The hybrid function of three parameters (B3) and Lee-Yang-Parr functional correlation (LYP) (a functional correlation that has local and non-local terms). The function has a good approach in the calculation of molecular structures and vibrational frequencies (Lee, 1988; Becke, 1993; Wu et al., 2012; Huang et al., 2016). The use of two or more scale factors is acceptable, but it necessarily depends on your data set's size and how the expected modes are different from the expected (Bauschlicher, 1997; Bauschlicher, 2010; Mattioda and Bauschlicher, 2017). The symmetries, vibrational assignments and calculations of potential energy distribution (PED) were performed with a lofty degree of accuracy. The VEDA software optimizes the set of internal coordinates for the development of experimental/theoretical IR/Raman systems. The PED calculations were performed with the support of the VEDA 4 program (Jamróz, 2004 and Jamróz, 2013).

### 2.4 Processing data

Experimental and theoretical results were pre-treated with multivariate analysis, through Pearson correlation and principal component analysis (PCA), which was applied in a set of pre-defined spectra in the digital printing region of the data. Correlation and PCA data were acquired using RStudio 0.4.7 software. Statistical analysis was initially used to survey differences between samples and search for a match between raw data (Bueno et al., 2017; Nazife et al., 2019).

## 3. Results and Discussion

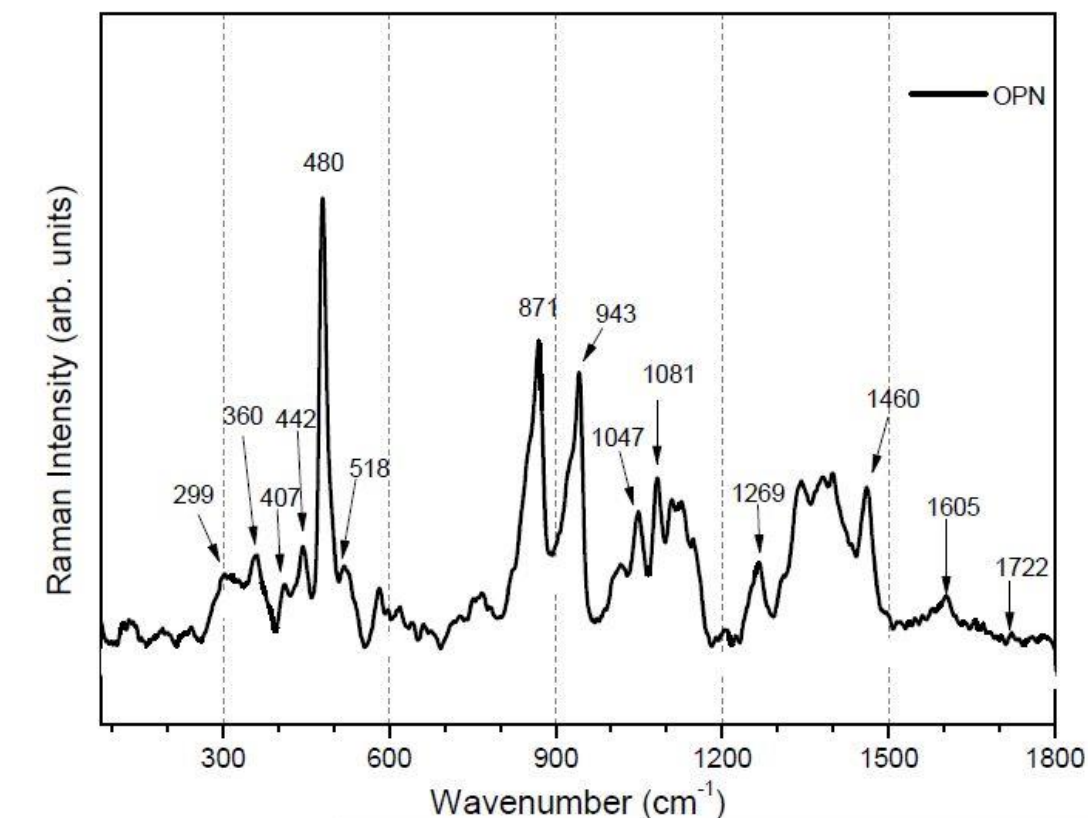
Figures and Tables: Figures 2(a) and (b) show the Raman spectrum of the sample throughout the results. Figure 3 shows the DFT calculation results for the molecules in Figure 1. The Table 1 gives an overview



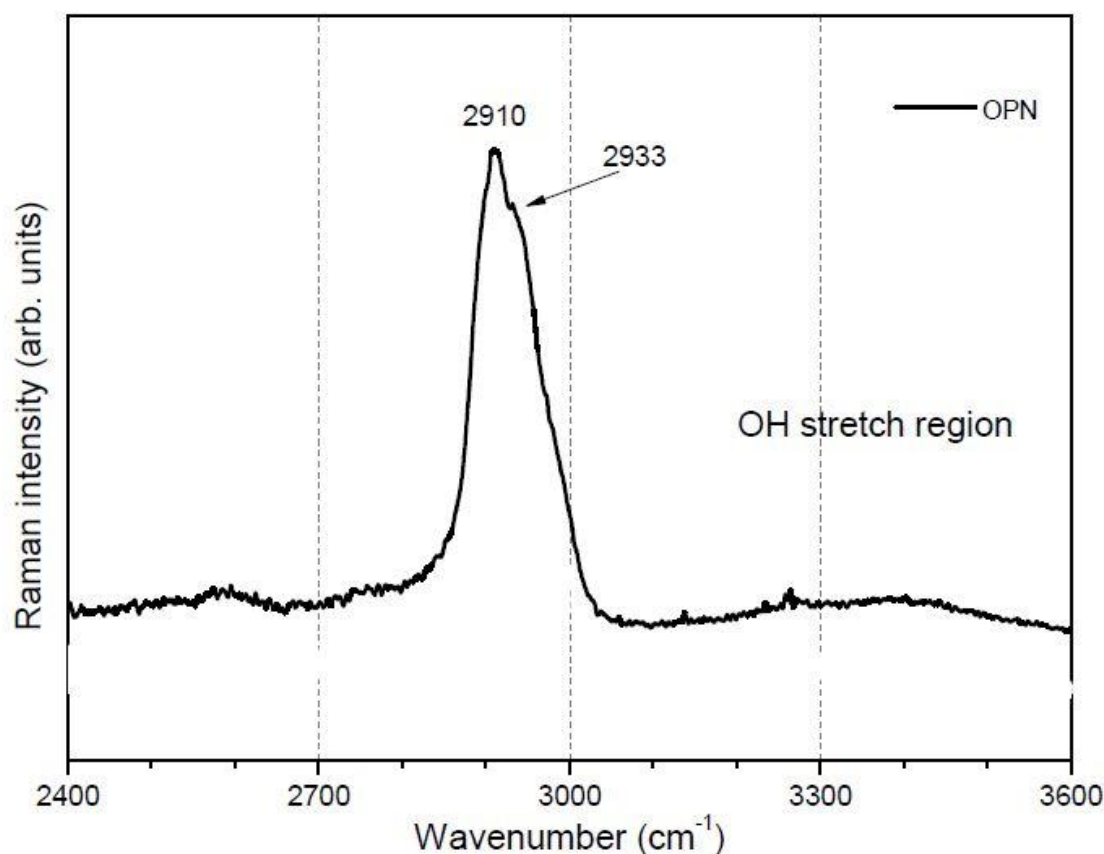
of the Raman bands of the samples (experimental/theoretical) investigated. In Tables S2 to S7 (Supplementary material), the DFT calculation (GAUSSIAN and VEDA results) is observed, and Figure 4(a) and (b) shows the statistics of the frequency range and comparison.

### 3.1 Experimental data

The RS spectrum of OPN is shown in a research window comprising the region between 80 - 1800  $\text{cm}^{-1}$  and between 2400 - 3600  $\text{cm}^{-1}$  (Figure 2). What is seen initially is that this region between 80 - 1800  $\text{cm}^{-1}$  (Figure 2(a)) shows a great density on bands of the spectrum, already in Figure 2(b), a band with overlapping basis with peaks centered at 2910  $\text{cm}^{-1}$  and 2933  $\text{cm}^{-1}$ .



a) Measured between 80 and 1800  $\text{cm}^{-1}$ .



b) Measured above 2400  $\text{cm}^{-1}$ .

Figure 2. Experimental Raman spectrum of OPN flour. The spectra were measured in different regions between: a) 80 - 1800  $\text{cm}^{-1}$ . In b) the range from 2400 to 3600  $\text{cm}^{-1}$  is shown.

The spectra were obtained under strong fluorescent curves of the sample, probably due to chlorophyll, typical in plants. In this case, because it is a photosynthetic pigment, chlorophyll has a strong absorption at 430 and 660 nm, precisely in the range of the laser line used in the procedure (Saleem et al., 2020). In Figure 2(a) see the peak of 480  $\text{cm}^{-1}$ . At first, this band may be pectins, acids present in the cell walls of plants. They may be related to one of C–O–C group elongation and deformation in the range 335-900  $\text{cm}^{-1}$  (Sene et al., 1994), where results can be linked to phenolic compounds since this band is common in rutinose, quercetin and isorhamnetin, in 484, 480 and 588  $\text{cm}^{-1}$  respectively. The peak at 480  $\text{cm}^{-1}$  can also be related to plant fiber lignin or cellulose; this can be explained because the region between 390  $\text{cm}^{-1}$  and 1100  $\text{cm}^{-1}$  vibrational bands both from lignin and cellulose coexist (Connors and Banerjee, 1995). These polysaccharides in the plant's fiber, combined with laser orientation, maybe the cause of this intense nature. Also, in this region (330-850  $\text{cm}^{-1}$ ), the band at 854  $\text{cm}^{-1}$  may be related to deformation modes (Thygesen and Gierlinger, 2013). Thus, the peak at 871  $\text{cm}^{-1}$  may also have some indication for deformation modes, and may be an indicator for the presence of caffeic acid, which contains HC=CH group deformations. Therefore, peaks at 871  $\text{cm}^{-1}$  and 943  $\text{cm}^{-1}$  can be referenced in the region indicated for the OPN sample. The commented region could be researched in the space between 450 to 1000  $\text{cm}^{-1}$  and cite that the evidence of aromatic cyclic could reveal the existence of an atom as nitrogen. However, it would not be a sensible search since its manners would resemble those already existing, especially those of the CH group (Mattioda and Bauschlicher, 2017).

Vibrational activities at 1081, 1276, 1380, 1399, 1460  $\text{cm}^{-1}$  that may bring references to deformations CH, COH, CO groups, and peaks of important phenolic constituents can be evidenced around 1430  $\text{cm}^{-1}$  and at 1600  $\text{cm}^{-1}$ , related to the stretching of aromatic compounds, in the case of flavonoids (Sene et al., 1994). Less intense marks at 1605, 1655, 1722  $\text{cm}^{-1}$  bands would appear in an important characterization region, as they can usually bring sense to the presence of C=C, aromatic or polycyclic substitution groups, and C=O, which are normally present in organic compounds, already reported to contain antioxidant and phenolic content. Thus, isorhamnetin (1652  $\text{cm}^{-1}$ ), kaempferol (1656  $\text{cm}^{-1}$ ), and quercetin (1659  $\text{cm}^{-1}$ ) bring a good correspondence of C=C stretching modes for OPN. The region between 1000 and 1500  $\text{cm}^{-1}$  can indicate the folding of CH<sub>2</sub> and CH<sub>3</sub> modes. Containing a significant number of carboxylic acids in the same region, it may be responsible for the possible ways of stretching and folding in RS. The bands at 357, 518, 942, 1605, and 1745  $\text{cm}^{-1}$  may be associated with pectins and lignins (Lupoi et al., 2015; Agarwal, 2019; Makarem et al., 2019). The Figure 2(b), a wide band, overlapping two bands with center peaks at 2910  $\text{cm}^{-1}$  and 2933  $\text{cm}^{-1}$ , is present in the CH<sub>2</sub> and CH<sub>3</sub> stretch region. In an assignment, the methyl group may contain symmetrical and asymmetric stretching modes, and if associated with isorhamnetin (Table S3), these bands are at 3022  $\text{cm}^{-1}$  and 3094  $\text{cm}^{-1}$ . In the theoretical RS, associated with OH stretches, this region presents between 2750 and 3450  $\text{cm}^{-1}$  and between 3150 and 3500  $\text{cm}^{-1}$ .

### 3.1 Calculation date

The theoretical RS (T-RS) is shown in Figure 3 and reported to the structures in Figure 1, identified by capital letters.

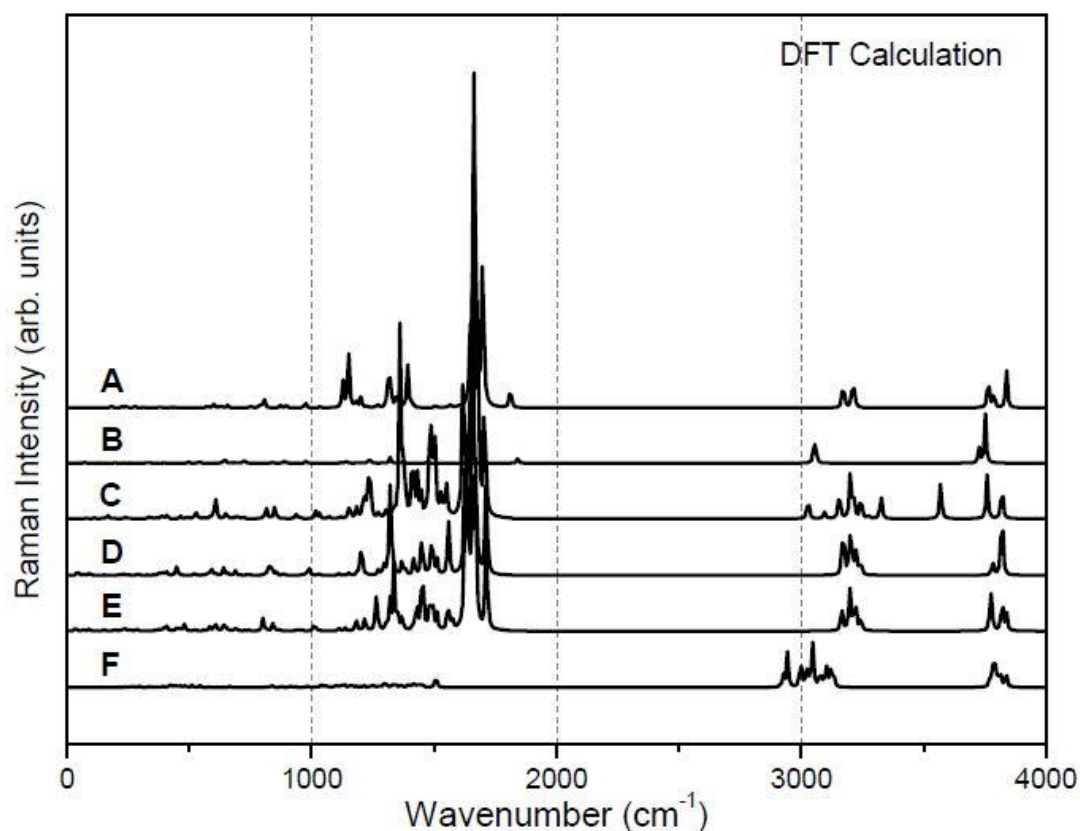


Figure 3. Raman spectra from DFT at Caffeic acid (A), Tartaric acid (B), Isorhamnetin (C), Kaempferol (D), Quercetin (E) and Rutinose (F) molecules. Functional B3LYP polarized for 631G(d,p) base set was used.

The T-RS are shown across the spectrum, between 80  $\text{cm}^{-1}$  and 4000  $\text{cm}^{-1}$ . The calculations show discrete

bands between  $3000\text{ cm}^{-1}$  and  $4000\text{ cm}^{-1}$ , which can be linked to groups CH and OH. The region below  $1000\text{ cm}^{-1}$  shows low-intensity bands, bringing important meanings since the theoretical data can bring correspondence with the experimental data. The caffeic acid structure (A), shows a planar distribution after optimization, so we can classify that the existing modes can be in the plane or outside the plane. The T-RS of A brings low intensity modes in regions below  $1000\text{ cm}^{-1}$ , presenting out-of-the-plane deformation (torsion) modes for OH at  $241\text{ cm}^{-1}$ . The band at  $806\text{ cm}^{-1}$  rings an asymmetric elongation of the carbon atoms adjacent to the ring replacement. Torsion modes in the plane identified for the CH groups of the carbon and the COOH radical and at  $1127$  and  $1150\text{ cm}^{-1}$ , respectively. The region between  $1250\text{ cm}^{-1}$  and  $1500\text{ cm}^{-1}$  bring torsion modes in the CH and OH plane all the structure. Bands of medium and high-intensity corresponding identify the bands at  $1647$  and  $1666\text{ cm}^{-1}$  to the C=C connections and respective symmetrical stretching modes. At  $1698\text{ cm}^{-1}$ , we have a symmetrical stretching mode of C=C, but this time for atoms attached to the carboxyl radical. The band at  $1811\text{ cm}^{-1}$  reports to the C=O group with symmetrical elongation. In the region next  $3800\text{ cm}^{-1}$ , we have 3 modes of symmetrical stretching for the OH present in the structure. The T-RS of tartaric acid (B) contains well-defined bands across the spectrum. Between 0 and  $1500\text{ cm}^{-1}$ , a series of structure deformation modes, all related to the OH group. The band at  $1840\text{ cm}^{-1}$  groups the symmetric stretching modes of the two existing C=O groups. Between  $3000$  and  $3100\text{ cm}^{-1}$ , there are two bands, one at  $3049\text{ cm}^{-1}$  and another at  $3058\text{ cm}^{-1}$ , responsible for the asymmetric and symmetric stretching of CH modes. The isorhamnetin molecule (C) spectrum has bands in at  $605$ ,  $814$ ,  $849\text{ cm}^{-1}$  with structure deformation modes. Bands between  $1200$  and  $1500\text{ cm}^{-1}$  are associated with OH's angular deformations including bands at  $1500\text{ cm}^{-1}$  methyl groups. Between  $1600$  and  $1750\text{ cm}^{-1}$ , we have axial deformations of the aromatics. The bands between  $300$  and  $3400\text{ cm}^{-1}$  are attached to the group  $\text{CH}_3$  and CH, with symmetrical stretching modes in  $3028$  and  $3275\text{ cm}^{-1}$ , respectively. At  $3094$  and  $3155\text{ cm}^{-1}$ , asymmetric stretch modes. Bands above  $3325\text{ cm}^{-1}$  are responsible for symmetrical stretches of OH. The kaempferol (D) shows deformation of the structure below  $1000\text{ cm}^{-1}$ . These low-intensity but notable bands are at  $449$ ,  $589$ ,  $639$ ,  $835$ , and  $998\text{ cm}^{-1}$ . The  $1200\text{ cm}^{-1}$  band may be related to the OH and CH deformation mode of the benzene group. Between  $1200$  and  $1600\text{ cm}^{-1}$ , we have structural deformation related to the OH group in the molecule. At  $1625\text{ cm}^{-1}$ , we have a symmetrical stretch of the C=C group of cyclic compounds linked to the substitution and at  $1655\text{ cm}^{-1}$ , the most intense contribution from C=C. We have contributions located in three different bands, at  $1666$ ,  $1674$  and  $1713\text{ cm}^{-1}$ , accompanied by harmonics for CC and CH. The CH symmetric and asymmetric stretching modes are found in  $3225$  and  $3210\text{ cm}^{-1}$ . Two OH bands appear at  $3781$  and  $3819\text{ cm}^{-1}$ . The result for quercetin (E) brings little vibrational activity below  $1200\text{ cm}^{-1}$ . In this region, a weak band at  $480\text{ cm}^{-1}$  (OH twist mode and ring deformation) agrees with experimental results. The band at  $803\text{ cm}^{-1}$  (CH deformation) is one of the bands that stand out, as they correspond to a mode that covers a group  $\text{HC}=\text{C}=\text{CH}$  (linked to one of the flavonoid rings). Bands between  $1200$  and  $1600\text{ cm}^{-1}$  are assigned to CH and OH deformation modes. The C=C symmetrical stretch modes are present in  $1629$ ,  $1658$  and  $1667\text{ cm}^{-1}$  and correspond to the T-RS's most intense bands. The bands at  $1673$  and  $1714\text{ cm}^{-1}$  indicate modes of symmetrical stretching of C=O and OH deformation. The bands around  $3200\text{ cm}^{-1}$  bring CH stretch modes and above  $3500\text{ cm}^{-1}$  OH symmetrical stretch modes. For rutinose (F), we have 3 distinct regions with low-intensity bands between 0 and  $1500\text{ cm}^{-1}$ , medium and high between  $2800$ ,  $3200$ ,  $3750$  and  $4000\text{ cm}^{-1}$ . The first region mentioned, with bands between  $200$  and  $600\text{ cm}^{-1}$ , is linked to OH bending modes. Marked OH bands are seen at  $297$ ,  $335$ ,  $353$ ,  $392$ ,  $417$ ,  $425$ ,  $443$  and  $461\text{ cm}^{-1}$ . The other bands in this region refer to the deformation of the molecule. The region between  $2900$  and  $3200\text{ cm}^{-1}$  contains intense bands for CH and  $\text{CH}_3$  presenting symmetric stretch modes in  $2927$ ,  $2944$ ,  $2997$ ,  $3105$ ,  $3122\text{ cm}^{-1}$  for CH, and at  $3047\text{ cm}^{-1}$  for  $\text{CH}_3$  and asymmetric stretch mode for  $3092\text{ cm}^{-1}$  and  $3122\text{ cm}^{-1}$  for CH and  $\text{CH}_3$  respectively. The bands in the  $3800\text{ cm}^{-1}$

<sup>1</sup> region are all in OH symmetrical stretch modes. Tables S2 to S7 (Supplementary Material) show the experimental and theoretical results' vibrational frequencies, accompanied by scaled frequencies (scale factor 0.961) and percentage and vibrational contribution by molecular group (PED). The vibrations in the Tables are labeled as symmetrical ( $\nu_s$ ) and asymmetric ( $\nu_{as}$ ) and deformations in the plane: scissoring ( $\delta_{sci}$ ) and rocking ( $\delta_{roc}$ ), or out-of-plan, wagging ( $\delta_{wag}$ ) and twisting ( $\delta_{twi}$ ). In general, the result shows that the highest percentage contributions are to the OH group, generally above 90% PED. It is interesting to note that such an individual contribution does not add up to the experimental data and is considered unassigned (NA). An extensive discussion in the literature (Nyquist and Kagel, 1971; Mahesar et al., 2014; Huang et al., 2016; Larkin, 2018; Toposki, 2018; Costa et al., 2019; Hoang, 2020) bases the bands between 600 and 4000  $\text{cm}^{-1}$ , however, below 600  $\text{cm}^{-1}$  this is not that simple. In this sense, it uses the computational method since, in RS, we can have bands well below 500  $\text{cm}^{-1}$ . Table 1 shows caffeine, isorhamnetin and rutinose with linked bands in the OPN sample. In the O-H stretching region, above 3100  $\text{cm}^{-1}$ , are shown in the supplementary materials.

Table 1. Overview of the observed experimental and DFT calculations Raman bands (in  $\text{cm}^{-1}$ ) and assignments of the main vibrational modes by molecular group.

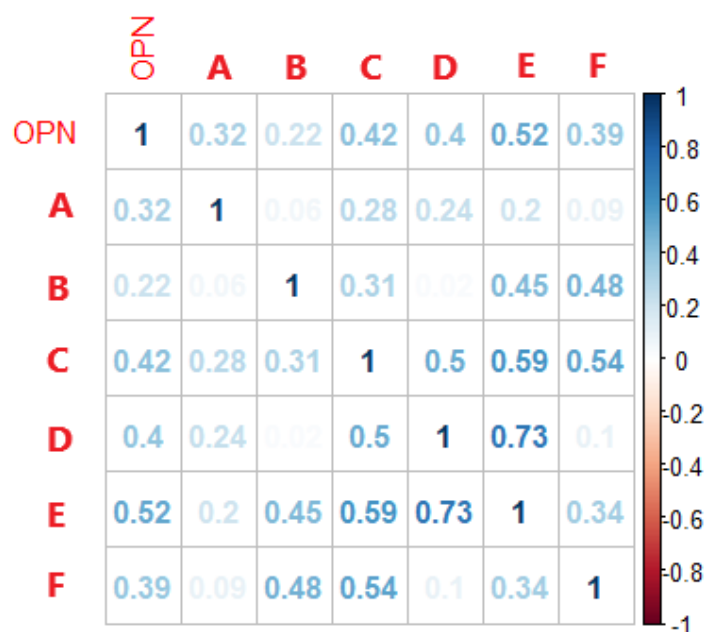
OPN	Caffeine	Tartaric	Isorhamnetin	Kaempferol	Quercetin	Rutinose	Assignment
2933	-	-	3095	-	-	-	$\nu_s$ (CH)
-	-	-	-	-	-	3048	$\nu_s$ (CH)
-	-	-	-	-	-	3027	$\nu_s$ (CH)
2910	-	-	3028	-	-	3027	$\nu_s$ (CH)
1722	1812	1842	1652	1675	1674	-	$\nu_s$ (O=C)
-	1699	-	-	-	-	-	$\nu_s$ (C=C) ring
-	1667	-	-	-	1668	-	$\nu_s$ (C=C) ring
1655	1648	-	1652	1656	1659	-	$\nu_s$ (CC)
1399	1410	-	-	-	-	-	$\nu_s$ (CC)
1380	1392	1380	1378	1381	-	-	$\nu_s$ (CC)
1342	1348	1353	1336	1336	1337	1341	$\delta$ (HCC), $\nu_s$ (CC)
1267	1270	-	1274	1273	1263	1277	$\delta$ (HCC), (HOC)
1127	1128	1118	1118	-	1135	1134	$\delta$ (CCC), $\nu_{OC}$
871	871	872	-	-	-	877	$\delta$ (HCCO), HCCC
580	580	-	588	589	582	583	$\delta$ (HOCC), (CCC)
443	-	-	-	449	443	443	$\delta$ (HOCC), $\nu$ (CC) backbone
130	138	130	-	-	-	-	$\delta$ (OCCC)

Table 1 is labeled as symmetrical ( $\nu_s$ ) and deformations ( $\delta$ ) vibrations.

### 3.2 Exploratory principal component analysis

The results of the E-RS (experimental) and T-RS (theoretical) combined are shown in Figure 4, which

concerns Pearson's correlation, from the interaction between bands admitted in the region between 80 and 1800  $\text{cm}^{-1}$ . Other regions that are left out of the analysis (over 2000  $\text{cm}^{-1}$ ) have a low overall signal-to-noise ratio or are composed exclusively of CH and OH bands, which are very common in organic products. The chosen region comprises the so-called digital printing region of components. The results show that the highest correlations are given between structures associated with flavonoids. These are precisely the ones that most correspond to the experimental data, with a moderate positive correlation of 0.519. All have a positive correlation between themselves (Figure 4a). The PCA was then applied to the indicated region. It was demonstrated that the total variance of the data set could be explained by seven main components, where the first two main components (Dim 1 and Dim 2), with eigenvalue greater than 1, explain approximately 64.02% of the total variance (Figure 4b). The main PCA components' highest loads showed that the main differences in sample discrimination were around 596-751  $\text{cm}^{-1}$ , 1147-1460  $\text{cm}^{-1}$  and 1655-1722  $\text{cm}^{-1}$ . Bands from these regions are discriminated by twisting deformations, scissoring and stretching of OC, CC, C=C and C=O groups respectively. The PCA result was consistent when comparing E-RS and T-RS data, understanding that among the most significant components of OPN, there is association with the studied flavonoids. A prediction of this nature can be seen in Supplementary material.



a)



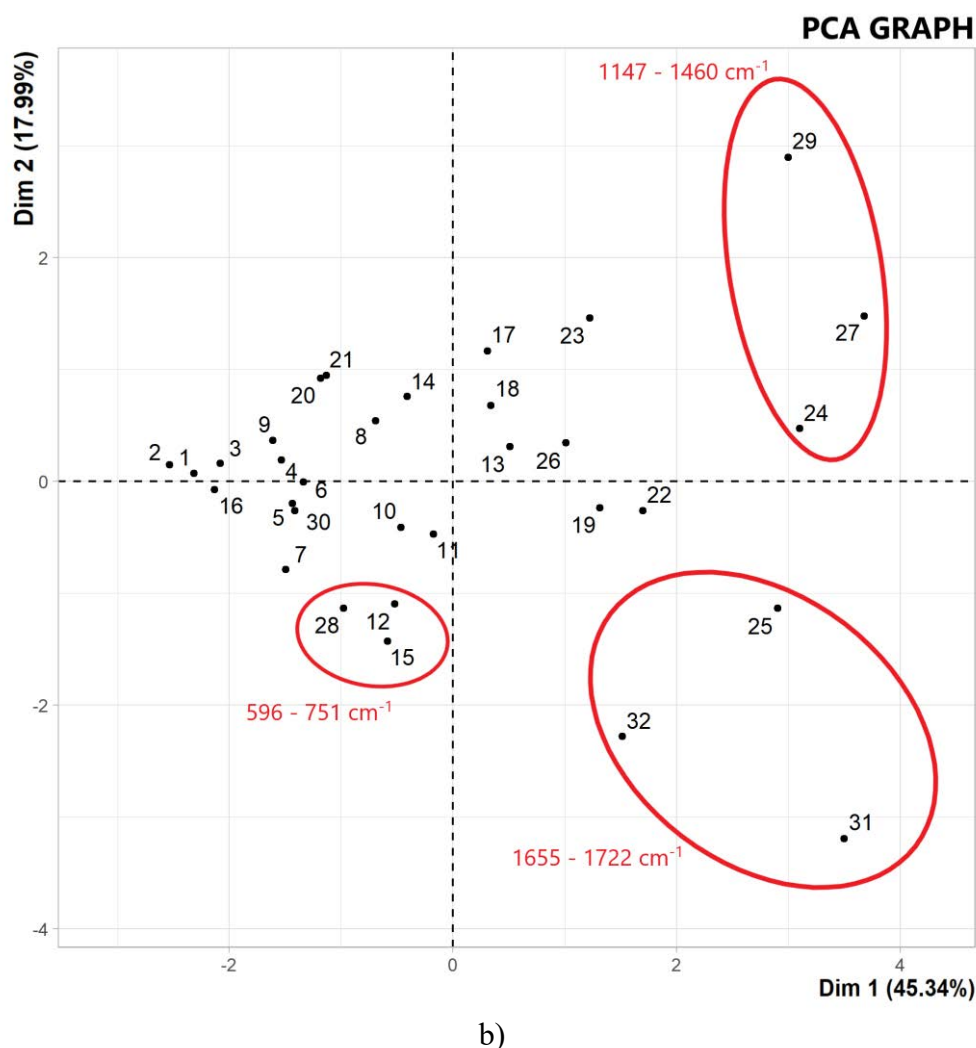


Figure 4. a) Correlation graph and b) PCA data set between experimental and theoretical data from Raman spectrum. Pearson correlation obtained after 21 interactions.

#### 4. Conclusion

Through RS, vibrational signatures of OPN were successfully acquired, and DFT data were important in discriminating these signatures. These signatures showed very significant bands at 480, 871 and 943  $\text{cm}^{-1}$ . These bands were related to ways of deformation of plant components. Molecular groups of OC and CH bonds are quite abundant in the region below 1600  $\text{cm}^{-1}$  due to phenolic constituents. The T-RS have low intensity bands for regions below 1200  $\text{cm}^{-1}$  but bring important modes that relate to the experimental data. The DFT method was able to identify important bands such as C=O, between 1722 and 1750  $\text{cm}^{-1}$  and CH<sub>3</sub> groups around 3000  $\text{cm}^{-1}$ , which served as the basis for the interpretation of the experimental curve. Of the calculated constituents, phenolics showed higher affinity patterns with the OPN sample. The PCA data indicated that these correspondences are greater due to clusters in the regions of 596-751  $\text{cm}^{-1}$ , 1147-1460  $\text{cm}^{-1}$  and 1655-1722  $\text{cm}^{-1}$ . The OH symmetrical stretching modes are evident in the theoretical data. Still, the experimental data is not clear because (OH) above 3200  $\text{cm}^{-1}$  a long band is formed, which cannot be attached to the group of hydroxyl.

#### 5. Acknowledgement

The authors would like to thank the Optics and Nanoscopy Group (GON) of the Universidade Federal de Alagoas, the Laboratório de Espalhamento de Luz of the Universidade Federal de Mato Grosso, the Grupo

de Pesquisa em Estrutura da Matéria e Física Computacional of DEFIJI/UNIR and the agreement FAPERO/CAPES (Grant: 008/2018).

## 6. Author statement

Q.S. Martins: Conceptualization, Methodology, Project administration, Writing - Original Draft. N.F. Arinos: Data curation, Visualization, Investigation, Writing - Original draft preparation. C. Aguirre: Software, Validation, Data curation. J.L.B. Faria: Supervision, Project administration, Methodology, Writing- Reviewing and Editing.

## 7. Declaration of interests

The authors declare no conflict of interest relationship in this paper.

## 8. References

- Agarwal UP, Analysis of Cellulose and Lignocellulose Materials by Raman Spectroscopy: A Review of the Current Status, *Molecules*, 2019, 24, 1659. <https://doi.org/10.3390/molecules24091659>
- Alston JM, Beddow JM, Pardey PG, Agricultural Research, Productivity, and Food Prices in the Long Run. *Science*, 2009, 325, 1209–1210. DOI:10.1126/science.1170451
- Bauschlicher CW, Langhoff SR, The calculation of accurate harmonic frequencies of large molecules: the polycyclic aromatic hydrocarbons, a case study, *Spectrochim. Acta A*, 1997, 53, 1225-1240. [https://doi.org/10.1016/S1386-1425\(97\)00022-X](https://doi.org/10.1016/S1386-1425(97)00022-X)
- Bauschlicher CW, Ricca A, On the calculation of the vibrational frequencies of polycyclic aromatic hydrocarbons, *Mol. Phys.*, 2010, 108, 2647-2654. <http://dx.doi.org/10.1080/00268976.2010.518979>
- Becke AD., Density-functional thermochemistry. III. The role of exact exchange, *J. Chem. Phys.*, 1993, 98, 5648. <https://doi.org/10.1063/1.464913>
- Bunaciu A, Aboul-Enein HY, Hoang VD, *Vibrational Spectroscopy Applications in Biomedical, Pharmaceutical and Food Sciences*, Copyright, Elsevier Inc., 2020, 15-36.
- Calixto C, Thiemi D, Natally K, Souza P, Crestani S, Gasparotto A, Laverde U., Involvement of arginine-vasopressin in the diuretic and hypotensive effects of *Pereskia grandifolia* Haw. (Cactaceae), *J. Ethnopharmacol*, 2012, 144, 86-93. <https://doi.org/10.1016/j.jep.2012.08.034>
- Connors T, Banerjee S, *Surface Analysis of Paper*. Ed. CRC, Mississippi, 1995.
- Costa, Agostini-Costa TS., Bioactive compounds and health benefits of Pereskioideae and Cactoideae: A review, *Food Chem.*, 2020, 327, 126961. <https://doi.org/10.1016/j.foodchem.2020.126961>
- Costa S, Richter A, Schmidt U, Breuninger S, Hollricher O, Confocal Raman microscopy in life sciences, *Morphologie*, 2019, 103, 11-16. <https://doi.org/10.1016/j.morpho.2018.12.003>
- Desa, U., Population division working paper no. ESA/P/WP, 2015, 241.
- Ditchheld R, Hehre WJ., Pople JA, Self-Consistent Molecular-Orbital Methods. IX. An Extended Gaussian-Type Basis for Molecular-Orbital Studies of Organic Molecules, *J. Chem. Phys.*, 1971, 54, 724.

<https://doi.org/10.1063/1.1674902>

Erdogdu Y, Baskose UC, Saglam S, Erdogan M, Ogutcu H, Özçelik S., Structural, thermal, spectroscopic, electronic and biological activity properties of coumarin-153 dyes for DSSCs: A DFT benchmark study, *J. Mol. Struc.*, 2020, 1221, 128873. <https://doi.org/10.1016/j.molstruc.2020.128873>

Ferreres F, Grosso C, Gil-Izquierdo A, Valentao P, Mota AT, Andrade PB., Optimization of the recovery of high-value compounds from pitaya fruit by-products using microwave-assisted extraction, *Food Chem.*, 2017, 230, 463–474. <https://doi.org/10.1016/j.foodchem.2017.03.061>

Garcia AAJ, Corrêa RCG, Barros L, Pereira C, Abreu RMV, Alves MJ, Calhella RC, Bracht A, Peralta RM, Ferreira IC, Phytochemical prole and biological activities of 'Ora-Pro-Nóbis' leaves (*Pereskia aculeata* Miller), an underexploited superfood from the Brazilian Atlantic Forest, *Food Chem.*, 2019, 294, 302-308. <https://doi.org/10.1016/j.foodchem.2019.05.074>

Gaussian 03, Revisão C.02, MJ Frisch, GW Trucks, HB Schlegel, GE Scuseria, MA Robb, JR Cheeseman, JA Montgomery, Jr., T. Vreven, KN Kudin, JC Burant, JM Millam, SS Iyengar, J. Tomasi, V. Barone, B. Mennucci, M. Cossi, G. Scalmani, N. Rega, GA Petersson, H. Nakatsuji, M. Hada, M. Ehara, K. Toyota, R. Fukuda, J. Hasegawa, M. Ishida, T. Nakajima, Y. Honda, O. Kitao, H. Nakai, M. Klene, X. Li, JE Knox, HP Hratchian, JB Cross, V. Bakken, C. Adamo, J. Jaramillo, R. Gomperts, RE Stratmann, O. Yazyev, AJ Austin, R. Cammi, C. Pomelli, JW Ochterski, PY Ayala, K. Morokuma, GA Voth, P. Salvador, JJ Dannenberg, VG Zakrzewski, S. Dapprich, AD Daniels, MC Strain, O. Farkas, DK Malick, AD Rabuck, K. Raghavachari, JB Foresman, JV Ortiz, Q. Cui, AG Baboul, S. Clifford, J. Cioslowski, BB Stefanov, G. Liu, A. Liashenko, P. Piskorz, I. Komaromi, RL Martin, DJ Fox, T. Keith, MA Al-Laham, CY Peng, A. Nanayakkara, M. Challacombe, PMW Gill, B. Johnson, W. Chen, MW Wong, C. Gonzalez e JA Pople, Gaussian, Inc., Wallingford CT, 2004.

Gerland P, Raftery AE, Ševčíková H, Li N, Gu D, World population stabilization unlikely this century, *Science*, 2014, 346, 234-237. DOI:10.1126/science.1257469

Gierlinger N, Schwanninger M., The potential of Raman microscopy and Raman imaging in plant research, *J. Spectrosc.*, 2007, 21, 69. <https://doi.org/10.1155/2007/498206>

Godfray H, Beddington JR, Crute I, Haddad L, Lawrence D, Muir J, Pretty J, Robinson S, Thomas S, Toulmin C, Food Security: The Challenge of Feeding 9 Billion People, *Science*, 2010, 327, 812–818. DOI:10.1126/science.1185383

Goncalves ASM, Peixe RG, Sato A, Muzitano MF, Souza R, Machado TD, Leal I, *Pilosocereus arrabida* (Byles & Rowley) of the Grumari sandbank, RJ, Brazil: Physical, chemical characterizations and antioxidant activities correlated to detection of flavonoids, *Food Res. Int.*, 2015, 70, 110–117. <https://doi.org/10.1016/j.foodres.2014.10.009>

Hehre WJ, Ditchheld R, Pople JA., Self-Consistent Molecular Orbital Methods. XII. Further extensions of Gaussian type basis sets for use in molecular-orbital studies of organic-molecules, *J. Chem. Phys.*, 1972, 56, 2257. <https://doi.org/10.1063/1.1677527>

Huang F, Li Y, Guo H, Xu Z, Chen J, Zhang Y, Identification of waste cooking oil and vegetable oil via Raman spectroscopy, *J. Raman Spectrosc.*, 2016, 47, 860–864. <https://doi.org/10.1002/jrs.4895>

Hu R, He T, Zhang Z, Yang Y, Liu M, Safety analysis of edible oil products via Raman spectroscopy, *Talanta*, 2019, 191, 324-332. <https://doi.org/10.1016/j.talanta.2018.08.074>.

Jamróz, MH. Vibrational Energy Distribution Analysis, VEDA 4 program, Warsaw, Poland, 2004.

Jamróz MH, Vibrational Energy Distribution Analysis (VEDA): Scopes and limitations. *Spectroch. Acta A*, 2013, 114, 220–230. <https://doi.org/10.1016/j.saa.2013.05.096>

Kalasinsky KS, Hadheld T, Shea AA, Kalasinsky VF, Nelson MP, Neiss J, Drauch AJ, Vanni G, Treado P, Raman Chemical Imaging Spectroscopy Reagentless Detection and Identification of Pathogens: Signature Development and Evaluation, *Anal. Chem.*, 2007, 79, 2658-2673. <https://doi.org/10.1021/ac0700575>

Karacaglar N, Bulati T, Boyaci IH, Topcu A, Raman spectroscopy coupled with chemometric methods for the discrimination of foreign fats and oils in cream and yogurt, *J. Food Drug Anal.*, 2019, 27, 101-110. <https://doi.org/10.1016/j.jfda.2018.06.008>

Komjáti B, Urai Á, Hosztah S, Kökösi J, Kováts B, Nagy J, Horváth P., Systematic study on the TD-DFT calculated electronic circular dichroism spectra of chiral aromatic nitro compounds: A comparison of B3LYP and CAM-B3LYP, *Spectrochim. Acta A*, 2016, 155, 95-102. <https://doi.org/10.1016/j.saa.2015.11.002>

Larkin P, *Infrared and Raman Spectroscopy: Principles and Spectral Interpretation*, 2nd ed., Elsevier, 2018.

Lee C, Yang W, Parr RG, Development of the Colle-Salvetti correlation-energy formula into a functional of the electron density, *Phys. Rev. B*, 1988, 37, 785. <https://doi.org/10.1103/PhysRevB.37.785>

Lu L, Hu H, Hou H, Wang B., An improved B3LYP method in the calculation of organic thermochemistry and reactivity, *Comput. Theor. Chem.*, 2013, 1015, 64-71. <https://doi.org/10.1016/j.comptc.2013.04.009>

Lupoi J, Gjersing E, Davis EM, Evaluating Lignocellulosic Biomass, Its Derivatives, and Downstream Products with Raman Spectroscopy, *Front. Bioeng. Biotechnol.*, 2015, 3, 50. <https://www.frontiersin.org/article/10.3389/fbioe.2015.00050>

Machado DC, Pinto ND, Silva JM, Conegundes JLM, Gualberto ACM, Gameiro J, Scio E., *Pereskia aculeata*: A plant food with antinociceptive activity, *Pharm. Biol.* 2015, 1, 1780-1785. <https://doi.org/10.1016/j.jep.2015.07.032>

Mahesar SA, Sherazi S, Khaskheli AR, Kandhro AA, Uddin S, Analytical approaches for the assessment of free fatty acids in oils and fats, *Anal. Methods*, 2014, 6, 4956-4963. <https://doi.org/10.1039/C4AY00344F>

Makarem M, Lee CM, Kahe K, Huang S, Chae I, Yang H, Kubicki JD, Kim SH, Probing cellulose structures with vibrational spectroscopy, *Cellulose*, 2019, 26, 35–79. <https://doi.org/10.1007/s10570-018->

2199-z

Mattioda A, Bauschlicher CW, Infrared spectroscopy of matrix-isolated neutral polycyclic aromatic nitrogen heterocycles: The acridine series, *Spectrochim. Acta A*, 2017, 181, 286–308.  
<http://dx.doi.org/10.1016/j.saa.2017.03.044>

NIST, National Institute of Standards and Technology, 2020. <https://cccbdb.nist.gov/vibscalejust.asp>

Nogales-Bueno J, Baca-Bocanegra B, Rooney A, Hernández-Hierro JM, Byrne HJ, Heredia FJ, Study of phenolic extractability in grape seeds by means of ATR-FTIR and Raman spectroscopy. *Food Chem.*, 2017, 232, 602-609. <https://doi.org/10.1016/j.foodchem.2017.04.049>

Nyquist RA, Kagel RO, Handbook of infrared and Raman spectra of inorganic compounds and organic salts: infrared spectra of inorganic compounds, Academic press inc., 1971.  
Ozkan G, Sagdic O, Ekici L, Ozturk I, Ozkan M, J., Phenolic compounds of *Origanum sipyleum* L. extract, and Its antioxidant and antibacterial activities, *J. Food Lipids*, 2007, 14, 157-169.  
<https://doi.org/10.1111/j.1745-4522.2007.00077.x>

Petersson GA, Al-Laham M., A complete basis set model chemistry. II. Open-shell systems and the total energies of the rst-row atoms, *J. Chem. Phys.*, 1991, 94, 6081-90. <https://doi.org/10.1063/1.460447>  
Pinto N, Duque A, Pacheco N, Mendes R, Motta E, Bellozi P. Scio E, *Pharm. Biol.* 1, 2015 1780-1785.  
<https://doi.org/10.3109/13880209.2015.1008144>

Rakymzhan A, Yakupov T, Yelemessova Z, Bukasov R, Yakovlev VV, Utegulov ZN, Time-resolved assessment of drying plants by Brillouin and Raman spectroscopies, *J. Raman Spectrosc.* 2019, 50, 1881-1889. <https://doi.org/10.1002/jrs.5742>

Raman CV, Krishnan KS., The production of new radiations by light scattering. Part I *Proc. R. Soc. Lond. A. Math.*, 1929, 122, 23-35. <http://dspace.rii.res.in/handle/2289/2143>

Ramya T, Gunasekaran S, Ramkumaar GR., Density functional theory, restricted Hartree – Fock simulations and FTIR, FT-Raman and UV–Vis spectroscopic studies on lamotrigine, *Spectrochim. Acta A*, 2013, 114, 277-283. <https://doi.org/10.1016/j.saa.2013.05.057>

Rassolov VA, Pople JA, Ratner MA, Windus TL., 6-31G\* basis set for atoms K through Zn, *J. Chem. Phys.*, 1998, 109, 1223-29. <https://doi.org/10.1063/1.476673>

Rassolov VA, Ratner MA, Pople JA, Redfern PC, Curtiss L, 6-31G\* Basis Set for Third-Row Atoms. *J. Comp. Chem.*, 2001, 22, 976-984. <https://doi.org/10.1002/jcc.1058>

Saleem M, Atta BM, Ali Z, Bilal M, Laser-induced fluorescence spectroscopy for early disease detection in grape fruit plants, *Photochem. Photobiol. Sci.*, 2020, 19, 713–721.  
<https://doi.org/10.1039/C9PP00368A>

Saraiva AGQ, Saraiva GD, Albuquerque RL, Nogueira CES, Teixeira AMR, Lima LB, Cruz BG, Sousa F., Chemical analysis and vibrational spectroscopy study of essential oils from *Lippia sidoides* and of its

major constituent, *Vib. Spectrosc.*, 2020, 110, 103111. <https://doi.org/10.1016/j.vibspec.2020.103111>  
Schulz H, Baranska M., Identification and quantification of valuable plant substances by IR and Raman spectroscopy, *Vib. Spectrosc.*, 2007, 43, 13-25. <https://doi.org/10.1016/j.vibspec.2006.06.001>

Sene C, McCann MC, Wilson RH, Grinter R, Fourier-transform Raman and Fourier-transform infrared spectroscopy – an investigation of 5 higher plant cell walls and their components, *Plant Physiology*, 1994, 106, 1623–1631. <https://doi.org/10.1104/pp.106.4.1623>

Siger A, Nogala-Kalucka M, Lampart-Szczapa E., The content and antioxidant activity of phenolic compounds in cold pressed plant oils, *J. Food Lipids*, 2008, 15, 137-149. <https://doi.org/10.1111/j.1745-4522.2007.00107.x>

Silva DO, Seifert M, Nora FR, Bobrowski VL, Freitag RA, Kucera HR, Gaikwad NW, Acute Toxicity and Cytotoxicity of *Pereskia aculeata*, a Highly Nutritious Cactaceae Plant, *J. Med. Food*, 2017, 20, 403-409. <https://doi.org/10.1089/jmf.2016.0133>

Souza LF, Caputo L, Barros IBI, Fratianni F, Nazzaro F, De Feo V., *Pereskia aculeata* Muller (Cactaceae) Leaves: Chemical Composition and Biological Activities, *Int. J.Mol. Sci.*, 2016, 17, 1478. <https://doi.org/10.3390/ijms17091478>

Thygesen GL, Gierlinger N, The molecular structure within dislocations in *Cannabis sativa* bres studied by polarised Raman microspectroscopy, *J. Struc. Biol.*, 2013, 182, 219–225. <https://doi.org/10.1016/j.jsb.2013.03.010>

Toporski J, Dieing T, Hollricher O, *Confocal Raman microscopy* (2nd ed.), Springer Series in Surface Sciences (66), Springer International Publishing AG, 2018.

Vieira CR, Silva BP, Carmo MAV., Effect of *Pereskia aculeata* Mill. in vitro and in overweight humans: A randomized controlled trial, *J. Food Biochem.*, 2019, 43, e12903. <https://doi.org/10.1111/jfbc.12903>  
Wu X, Gao S, Wang JS, Wang H, Huang YW, Zhaod Y, The surface-enhanced Raman spectra of aflatoxins: spectral analysis, density functional theory calculation, detection and differentiation. *Analyst*, 2012, 137, 4226-34. <https://doi.org/10.1039/c2an35378d>

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).



### Supplementary material

In Tables S2 to S7, a set of experimental, theoretical (theoretical GAUSSIAN and VEDA) and scaled (0.961 scale factor) Raman frequencies is observed from the molecules in the Figure 1 mentioned. Vibrational mode assignments by molecular group and % PED contribution and Parameter maximum energy (EPM) also shown. The vibrations in the Tables are labeled as symmetrical ( $\nu_s$ ) and asymmetric ( $\nu_{as}$ ) and deformations (torsion) in the plane: scissoring ( $\delta_{sci}$ ) and rocking ( $\delta_{roc}$ ), or out-of-plan, wagging ( $\delta_{wag}$ ) and twisting ( $\delta_{twi}$ ).

**TABLE S2** Set of experimental, theoretical and scaled (scale factor 0.961) Raman frequencies of caffeic acid. Assignments of vibrational modes by molecular group and contribution % PED.

$\omega$ E-SR	$\omega$ T-SR	SF 0.961	Assignment PED %
NA	3839	3689	$\nu_s$ OH (2 20) 100
NA	3764	3617	$\nu_s$ OH (3 21) 100
NA	3206	3080	$\nu_s$ CH (6 14) 95
NA	3170	2986	$\nu_s$ CH (11 17) 99
1722	1812	1741	$\nu_s$ O=C (4 13) 80
NA	1699	1632	$\nu_s$ C=C <sub>ring</sub> (11 12) 52
NA	1667	1602	$\nu_s$ C=C <sub>ring</sub> (6 8) 31
1655	1648	1584	$\nu_s$ CC (10 9) 19
1399	1410	1355	$\nu_s$ CH CC (5 7) 11
1380	1392	1338	$\nu_s$ CC (5 7) 20
1342	1448	1295	$\delta_{sci}$ HCC (17 11 12) 25
1267	1270	1220	$\delta_{sci}$ HOC (18 12 13) 40
1127	1128	1084	$\delta_{sci}$ CCC (7 10 9) 16
871	871	837	$\delta_{twi}$ HCCO (18 12 13 3) 37
580	580	557	$\delta_{twi}$ HOCC (21 3 13 12) 41
130	138	132	$\delta_{twi}$ OCCC (3 13 12 11) 52

Caffeic acid. Average max. Potential Energy <EPM> = 43.915

**TABLE S3** Set of experimental, theoretical and scaled (scale factor 0.961) Raman frequencies of tartaric acid. Assignments of vibrational modes by molecular group and contribution % PED.

$\omega$ E-SR	$\omega$ T-SR	SF 0.961	Assignment PED %
NA	3727	3582	$\nu_s$ OH (1 13) 37 + (2 14) 62
NA	3727	3582	$\nu_{as}$ OH (2 14) 62 + (1 13) 37
NA	3752	3606	$\nu_s$ OH (3 15) 61 + (4 16) 39
NA	3752	3606	$\nu_{as}$ OH (4 16) 39 + (3 15) 61
NA	3058	2939	$\nu_s$ CH (8 12) 58 + (7 11) 37
NA	3050	2931	$\nu_{as}$ CH (8 12) 34 + (7 11) 55
1722	1842	1770	$\nu_s$ O=C (5 9) 36 + (6 10) 49
NA	1839	1767	$\nu_{as}$ O=C (5 9) 49 + (6 10) 36
1460	1452	1395	$\delta_{sci}$ HOC (13 1 7) 26
1380	1380	1326	$\delta_{sci}$ HCO (11 7 1) 15
1342	1353	1300	$\delta_{sci}$ HOC (14 2 8) 14
1311	1320	1668	$\delta_{sci}$ HCO (12 8 2) 17
1147	1141	1090	$\nu_s$ OC (1 7) 24
1127	1118	1074	$\nu_s$ OC (8 2) 32
871	872	837	$\nu_s$ CC (10 8) 20
190	195	187	$\delta_{tor}$ OCC (3 9 7) 11
130	130	125	$\delta_{tor}$ CCC (10 8 7) 20

Tartaric acid. Average max. Potential Energy &lt;EPm&gt; = 30.203

**TABLE S4** Set of experimental, theoretical and scaled (scale factor 0.961) Raman frequencies of isorhamnetin. Assignments of vibrational modes by molecular group and contribution % PED.

$\omega$ E-SR	$\omega$ T-SR	SF 0.961	Assignment PED %
NA	3820	3671	$\nu_s$ OH (6 31) 100
NA	3759	3612	$\nu_s$ OH (7 32) 100
NA	3570	3430	$\nu_s$ OH (2 29) 99
NA	3326	3196	$\nu_s$ OH (3 30) 99
NA	3245	3118	$\nu_s$ CH (15 24) 100
NA	3275	3147	$\nu_s$ CH (16 25) 100
NA	3242	3115	$\nu_s$ CH (17 26) 94
NA	3200	3075	$\nu_s$ CH (19 27) 100
NA	3213	3088	$\nu_s$ CH (21 28) 94
2933	3095	2974	$\nu_{as}$ CH <sub>3</sub> (23 33) 50
2910	3028	2910	$\nu_s$ CH <sub>3</sub> (23 34) 44
NA	1678	1612	$\nu_s$ C=C (12 9) 36
1722	1652	1587	$\nu_s$ O=C (5 13) 18
1655	1652	1587	$\nu_s$ C=C <i>ri ng</i> (18 15) 22
NA	1519	1469	$\delta_{sci}$ CH <sub>3</sub> (34 23 33) 56
NA	1501	1442	$\delta_{sci}$ CH <sub>3</sub> (35 23 33) 19
1460	1470	1413	$\nu_s$ CC (16 20) 10
1380	1378	1324	$\nu_s$ CC (15 10) 15
1342	1336	1284	$\nu_s$ CC (11 17) 15
1267	1274	1224	$\delta_{sci}$ HOC (31 6 18) 21
1147	1151	1106	$\delta_{sci}$ HCC (24 15 18) 12
1127	1118	1074	$\nu_s$ OC (1 10) 15
1081	1070	1028	$\nu_s$ OC (4 23) 51
1016	1016	976	$\nu_s$ CC (19 18) 17
943	950	913	$\delta_{twi}$ HCCC (26 17 21 22) 46
618	616	592	$\delta_{twi}$ OCCC (3 19 8 14) 24
580	588	565	$\delta_{sci}$ OCC (6 18 19) 14
243	241	232	$\delta_{twi}$ HOCC (19 18 15 10) 22
190	188	181	$\delta_{twi}$ CCCC (16 20 22 21) 32

Isorhamnetin. Average max. Potential Energy &lt;EPm&gt; = 37.152

**TABLE S5** Set of experimental, theoretical and scaled (scale factor 0.961) Raman frequencies of kaempferol. Assignments of vibrational modes by molecular group and contribution % PED.

$\omega$ E-SR	$\omega$ T-SR	SF 0.961	Assignment PED %
NA	3782	3634	$\nu_s$ OH (2 28) 100
NA	3821	3672	$\nu_s$ OH (5 30) 99
NA	3820	3671	$\nu_s$ OH (6 31) 99
NA	3167	3043	$\nu_s$ OH (3 29) 98
NA	3244	3117	$\nu_s$ CH (14 22) 100
NA	3198	3073	$\nu_s$ CH (16 23) 99
NA	3204	3079	$\nu_s$ CH (17 24) 93
NA	3225	3099	$\nu_s$ CH (18 25) 63
NA	3174	3050	$\nu_s$ CH (19 26) 93
1722	1675	1610	$\nu_s$ O=C (4 10) 23
1655	1656	1591	$\nu_s$ C=C (11 9) 34
1460	1451	1394	$\delta_{twi}$ HOC (29 3 13) 17
1380	1381	1327	$\delta_{twi}$ HOC (31 6 21) 21
1342	1336	1284	$\nu_s$ CC (12 17) 23
1267	1273	1223	$\delta_{twi}$ HOC (30 5 15) 28
1147	1152	1107	$\delta_{twi}$ HCC (22 14 15) 12
1016	1026	986	$\nu_s$ CC (15 14) 13
661	657	631	$\delta_{sci}$ CCC (17 19 21) 22
618	625	601	$\delta_{twi}$ HCCC (23 16 15 14) 11
580	589	566	$\delta_{sci}$ CCC (13 16 15) 19
443	449	431	$\delta_{twi}$ HOCC (28 2 11 9) 43
120	118	133	$\delta_{twi}$ CCCC (16 15 14 8) 23

Kaempferol. Average max. Potential Energy &lt;EPm&gt; = 34.350

**TABLE S6** Set of experimental, theoretical and scaled (scale factor 0.961) Raman frequencies of quercetin. Assignments of vibrational modes by molecular group and contribution % PED.

$\omega_{\text{E-SR}}$	$\omega_{\text{T-SR}}$	SF 0.961	Assignment PED %
NA	3772	3625	$\nu_s$ OH (2 28) 100
NA	3821	3672	$\nu_s$ OH (5 30) 100
NA	3839	3689	$\nu_s$ OH (6 31) 100
NA	3777	3630	$\nu_s$ OH (7 32) 100
NA	3166	3042	$\nu_s$ OH (3 29) 99
NA	3243	3116	$\nu_s$ CH (15 23) 100
NA	3197	3072	$\nu_s$ CH (17 24) 99
1722	1674	1647	$\nu_s$ O=C (4 13) 17
1655	1659	1594	$\nu_s$ C=C (12 10) 28
1460	1452	1395	$\nu_s$ CC (18 16) 12
1342	1337	1285	$\delta_{\text{sci}}$ HCC (26 19 21) 13
1267	1263	1214	$\delta_{\text{sci}}$ HCC (23 15 16) 22
1147	1143	1098	$\nu_s$ CC (21 19) 12
1127	1135	1091	$\delta_{\text{r oc}}$ HOC (31 6 20) 14
1109	1112	1069	$\delta_{\text{sci}}$ CCC (13 8 14) 16
1016	1011	971	$\nu_s$ CC (18 16) 13
728	726	698	$\delta_{\text{sci}}$ CCO (12 10 1) 12
661	659	633	$\delta_{\text{w ag}}$ OCCC (6 17 22 20) 17
618	619	595	$\delta_{\text{w ag}}$ OCCC (3 8 18 14) 27
580	582	559	$\delta_{\text{sci}}$ CCC (14 18 16) 14
480	480	461	$\delta_{\text{sci}}$ OCC (7 22 21) 13
443	443	426	$\delta_{\text{twi}}$ HOCC (28 2 12 10) 31
243	242	232	$\delta_{\text{twi}}$ HOCC (31 6 20 17) 80
190	196	188	$\delta_{\text{twi}}$ CCCC (21 19 11 17) 28

Quercetin. Average max. Potential Energy <EPm> = 32.220

**TABLE S7** Set of experimental, theoretical and scaloned (scale factor 0.961) Raman frequencies of rutinose. Assignments of vibrational modes by molecular group and contribution % PED.

$\omega$ E-SR	$\omega$ T-SR	SF 0.961	Assignment PED %
NA	3798	3650	$\nu_s$ OH (4 38) 98
NA	3784	3636	$\nu_s$ OH (5 39) 99
NA	3789	3641	$\nu_s$ OH (6 40) 100
NA	3786	3638	$\nu_s$ OH (7 41) 98
NA	3796	3645	$\nu_s$ OH (9 43) 100
NA	3133	3111	$\nu_{as}$ CH <sub>3</sub> (22 37) 73
NA	3122	3000	$\nu_s$ CH (12 24) 96
NA	3105	2984	$\nu_s$ CH (13 25) 97
NA	3076	2956	$\nu_s$ CH (18 30) 93
NA	3093	2972	$\nu_s$ CH (20 33) 81
2933	3047	2928	$\nu_s$ CH <sub>3</sub> (22 35) 47
2910	3026	2909	$\nu_s$ CH <sub>2</sub> (20 32) 77
NA	2927	2813	$\nu_s$ CH (11 23) 73
NA	2944	2829	$\nu_s$ CH (21 34) 85
1460	1453	1301	$\delta_{sci}$ HCO (40 6 14) 10
1342	1341	1289	$\delta_{twi}$ HCO (34 21 10) 32
1267	1277	1227	$\delta_{sci}$ HOC (41 7 15) 14
1147	1154	1109	$\nu_s$ OC (2 11) 22
1127	1134	1090	$\nu_s$ OC (9 19) 29
1081	1075	1033	$\nu_s$ CC (17 14) 16
1016	1022	982	$\nu_s$ CC (21 19) 20
871	877	843	$\nu_s$ CC (14 13) 19
661	666	640	$\delta_{twi}$ OCCC (5 14 16 13) 13
871	877	843	$\nu_s$ CC (14 13) 19
580	583	560	$\delta_{twi}$ COCC (11 2 21 19) 13
480	484	465	$\delta$ OCC (6 14 17) 12
443	443	426	$\delta_{tor}$ HOCC (40 6 14 13) 41
361	361	345	$\delta$ CCO (22 18 1) 14
248	243	233	$\delta_{sci}$ OCC (6 14 17) 12
120	124	119	$\delta_{wag}$ CCCC (17 14 13 16) 27

Rutinose. Average max. Potential Energy &lt;EPm&gt; = 32.966



# 8958 1 Dimensions for the Non-Financial Indicators Metric for Production Chains

Margarete Arbuseri, Maria Emilia Camargo, Antonio Jorge Fernandes, Maria Elisabeth Pereira,  
Isadora Arbuseri Menegotto  
UCS

## Abstract

*There's an apparent gap as in understanding how organizations measure performance. This gap is due to the nature and complexity of the Business Structure and the extent of the owner-managers who are willing to participate in the research process. Throughout the same argument, organizations within each link of the production chains do not have the understanding of their performance and how they should be measured. In order to investigate and get a better understanding of the performance of the links this research aims to contribute to the definition of the dimensions that are necessary to make up the metric of non-financial indicators for the measurement of the sustainability of the main and auxiliary production chains. Qualitative and in-depth convergent interview techniques are adopted with 5 managers of organizations of the vitiviní cola chain and who work at the international level. After collecting and analyzing the content of the metric, we seek to continue the studies by defining the variables that will compose each dimension. It was found that the metric should be composed of the following dimensions: environmental, social, economic, cooperation and trust.*

**Key words:** Non-financial indicators. Vitivinicola production chains. Sustainability of the Production Chain. Cooperation.

## 1. INTRODUCTION

In the literature, it is noticed that in the last decades the interest in the reactive business area, the measure of performance has increased significantly (Taticchi, Cagnazzo and Botarelli 2008; St-Pierre and Delisle 2006, Garengo, Biazzo and Bititci 2005; Jarvis, Curran, Kitching and Lightfoot 2000; Fisher 1992). According to Taticchi, Cagnazzo and Botarelli (2008), performance measurement evolved focusing on the perspective of financial strategy for a non-financial perspective. In order for companies remain in a dynamic and constantly changing environment, they have to monitor and measure the performance of their companies as well as the links in the chain in which it is inserted. As advocated by Sharma, Bhagwat and Dangayach (2005), performance measurement forms a critical component to improve the performance of a business organization.

According to Chong (2008), a large proportion of existing literature devoted everything about how large organizations measure their performance. And argues that there is an apparent gap in understanding how

companies measure performance. This gap is due to the nature and complexity of the Business Structure and the extent of the owner-managers who are willing to participate in the research process.

Throughout the same argument, organizations within each link of the production chains do not have the understanding of their performance and how they should be measured.

In order to investigate and give you a better understanding of the performance of the links, this research aims to contribute to the definition of the parameters that are necessary to compose the metric of non-financial indicators to measure the sustainability of the production chains. Interview techniques were used to converge qualitatively and in depth

## **1.2. Study justification**

According to Neely, Gregory and Platts (1995) performance measurement (PM) is a topic that is often discussed, but rarely defined. Literally, it's the process of quantifying the action,

Where measurement is the quantification process and action leads to performance. In other words, measure of performance means measuring costs, quality, quantity, cycle time, efficiency, productivity of products and services. Performance measurement is usually based on quantitative reports on which goals and objectives are set and accessed. Measurement is a phenomenon of the whole organization and such measures. They are interdependent and their aggregate contribution will reflect the effectiveness of total effort of the company (ZAIRI, 1993).

Thus, performance measurement is not only concerned with data collection, but is also associated with a predefined performance target or standard (JENSEN, 2003). What's more, performance measurement is best regarded as a general management system involving prevention and detection in order to achieve the conformity of the work product Or service (WEBSTER, 1992). Even with these definitions, performance measurements remain a broad topic.

Studies on performance measurement are generally conducted in business entities. Generally in the form of companies, SMEs and other profitable commercial enterprises. Not many studies have been conducted on measuring performance in the business of production chains.

However, it is perceived the need to measure the links of the production chains in function of if one of them is with gap reflects in all the other leading to non-sustainability of the entire chain. Thus, the aim of this study is to explore in depth the measure of the performance of organizations for production chains, defining the necessary needs to make up the metric of non-financial indicators for the medication of the sustainability of the production chains.

## **2 LITERATURE REVIEW**

### **2.1 MEASURING COMPANY PERFORMANCE**

According to Sun and Scott (2003), the critical success factors in the current dynamics and the competitive

business environment is very different from the past. Askenas, Ulrich, Jick and Herr (1995) argued that today's critical success factors are governed by speed, flexibility, integration and innovation. This represents a paradigm shift from success factors such as size, paper, clarity, specialization, and control.

The use of quantitative measurement tools that have been considered effective for moderate change is incapable and insufficient to measure the rapid change that characterized today's external environment. Sun and Scott (2003) the need for an effective measurement system through the use of quantitative resources and qualitative approaches. Therefore, taking sun and scott's suggestion, this research investigates performance measurement using the quantitative and qualitative method, Performance measurement is critical to improving companies.

Performance measures are used to track and track how the organization performs and whether it is meeting its objectives. The importance of the performance measure has increased with the finding that, in to be successful in the long term, organizations must meet the expectations and needs of stakeholders that include their customers, consumers, employees, suppliers, local community Stakeholders and shareholders. While the importance of measuring performance is to quantify.

According to Neely (1999), business performance can be measured by financial and non-financial indicators. Financial indicators are traditional performance measurement techniques used by companies that include profit, return on investment, sales and so on. Normally, it can be measured using the figures provided an financial statement of the company.

In addition to his study, Neely (1999) said that in the Business Environment where companies compete based on non-financial indicators they need information about how they are performing in a broader spectrum of dimensions, not only financially, but also factors in customers, employees, suppliers and the wider community. The combination of financial and non-financial indicators can lead to a balanced performance measurement in the business environment (KAPLAN; NORTON, 2000).

### **2.1.1 Measuring company performance: financial indicators**

The literature review identified five financial indicators for performance Measurement used in the company environment: profitability, cash flow position, return on investment, turnover and budget in relation to actual performance (NELLY; 2002; LUTHER ET AL. 2005; CHEN; SHIMERDA, 1981; MATSUMOTO et. al. 1995; SUN; LI 2006).

### **2.1.2 Measurement of company performance: non-financial indicators**

The literature has shown that there are four non-financial indicators that can be used as performance measures for companies: customer satisfaction, product or service quality, market share and employee efficiency ZAMAN, 2004; CIMA 1993; Fitzgerald et al. 1991; HASKETT et al. 1994; CHO; PUCIK 2005).

Some authors agree that customer satisfaction is an indicator for measuring business performance

(ZAMAN, 2004; CIMA, 1993; FITZGERALD et al. 1991; HASKET et al. 1994).

The four authors in their research stated that the quality of the products or services provided by companies are tools used to measure the performance of companies. The third indicator, as studied by Cho and Pucik (2005), illustrates the Relationship between quality, profitability and market share; And how these three indicators are related to the performance of companies. They found that market shares can be used as a benchmark to measure business performance. Employee efficiency was seen important by all companies (ZAMAN, 2004; CIMA, 1993).

Understanding that organizations basically consist of bureaucratic and hierarchical structures, trust becomes an informal mechanism for the coordination and control of organizational routine (RIPPERGER, 1998; WOLFF, 2000; ZANINI, 2007, 2011).

The existence of trust in bureaucratic relations considerably expands the potential to produce cooperative relationships and managerial efficiency, through the increase of managerial control generated by an informal mechanism (ZANINI, 2007).

According to Ripperger (1998), the presence of trust in interpersonal relationships within the organization allows the reduction of formal hierarchical control, while expanding the possibilities of the use of knowledge with a greater degree of autonomy, facilitating the elimination of redundancies and imperfect processes and allowing continuous improvement by reducing transaction costs. Thus, trust has been addressed as an essential informal element of coordination for the management of organizations (WOLFF, 1996; ZANINI, 2011).

The relationship between the confidence variable and many of the organizational performance variables has been proven in several studies. The existence of trust among the members of a company can contribute significantly to the increase of the efficiency of the various organizational tasks (DIRKS; FERRIN, 2001, 2002).

Its relevance has been observed mainly in the more specific and complex tasks, which involve greater risk and uncertainty (LUHMANN, 1980, 2000; OUCHI, 1980; COLEMAN, 1990; ADLER, 2001; DIRKS; FERRIN, 2001).

The informal role of trust in coordinating and controlling various tasks of the organization has been observed, for example, when it facilitates the process of knowledge transfer (ROBERTS, 2000; ROLLAND; CHAUVEL, 2000; MOSQUE; LAZZARINI, 2008; JENSEN; WEBSTER, 2009), improves organizational efficiency and productivity (AKERLOF, 1970; ARROW, 1974; OUCHI, 1980; RING; VAN DE VEN, 1992; BRADACH; ECCLES, 1998; LANE; BACHMANN, 1998; SAKO, 1998) and decreased transaction costs (KREPS, 1990; CHILES; MCMACKIN, 1996; BUTTER; MOSCH, 2003; ARGYRES, MAYER, 2007; ANDRADE, et al., 2011).

According to empirical studies on the subject, when there is a relationship of trust between people, the probability of exchanges and sharing of information increases, conflicts are reduced and satisfaction and motivation increase (DIRKS; FERRIN, 2001).

They also reduce costs related to the over-application of bureaucratic security instruments - such as monitoring, formal rules and procedures. In this sense, trust can also act as a facilitating element in disputes for decision making, allowing greater management flexibility.

### **3. QUALITATIVE RESEARCH**

The qualitative research method was used for this study. Lincoln and Guba (2000) agrees that qualitative research is used to obtain information about people's attitudes, values systems, concerns, motivations, aspirations, culture or lifestyles. It is used to inform business decisions, policy formation, communication and research. They also claim that focus groups, in-depth interviews, content analysis, ethnography, evaluation and semiotics are among the many formal approaches that are used, but qualitative research also involves the analysis of any unstructured material, including customer feedback forms, reports, or media clips.

According to Denzin and Lincoln (2000), qualitative research is also a type of scientific research. In general terms, scientific research consists of an investigation that: search answers a question, uses a predefined set of procedures to meet the question, collects evidence, produces results that have not been determined in advance, Produces results that are applicable beyond the immediate limits of the study (DENZIN; LINCOLN, 2000).

Qualitative research concerns the subjective assessment of attitudes, opinions and behavior (HOLME; SOLVANG, 1997). Research in such a situation is a function of insights and impressions of the researcher. This approach to research generates results either in a non-quantitative way or in the form that they are not subjected to rigorous quantitative analysis (HOLME; SOLVANG, 1997). In general, qualitative research is more likely to occur in a natural environment. In addition, it is said that qualitative research be exploratory, which is the collection, analysis and interpretation of data from respondents.

#### **3.1 JUSTIFICATION OF THE USE OF QUALITATIVE RESEARCH**

Over the past decade, there has been an increasing use of qualitative research in Organizations. Due to the subjective nature of this research method, it can be argued that quantitative research provides better results (BROWN et al., 2005). However, qualitative research can be used to explore various areas, such as human behavior

That can not be quantified, but still important for an organization. According to Jean Lee (2004), there are many reasons or advantages of using qualitative research in organizations and the main ones are: qualitative research provides a more realistic feel the world that cannot be experienced in numerical data and

statistical analysis used in quantitative research, provides flexible ways to collect, analyze and interpret data and information and the use of primary and unstructured data.

### 3.2 DATA COLLECTION METHOD

For this study, the convergent interview was used during the data collection process. According to Carson et al. (2001), the convergent interview is a methodology that allows a relatively structured approach to classify what needed to be done in a survey project in the early stages. It is also a technique for collecting, analyzing and interpreting qualitative information about people's attitudes, beliefs, knowledge and opinions through the use of a limited number of interviews with experts that converge at most Important issues within a topical area.

Semi-structured interviews were conducted with 5 people who were components of the links in the vitivinicola production chain, whose functions are listed in Table 1.

Table 1 - Searched

Activity	Link of the Wine Chain
Cooperative Manager	Matter before and industry
Employer Manager	Governanca entity of vitivinicola cooperatives
Enotourism Complex Manager	Industry, commercial productive chain vitivinicola and commercial of the gastronomy chain
Researcher at IES	Auxiliary chain - IES
Public Manager	Auxiliary chain - state government of RS

Source: prepared by the author

After being asked about the future and sustainability of the vitivinicola production chain, the interviewees above made notes regarding the survival of the chain after several crises of the sector that were filmed in the 1980s of the last century. The interviewees learned the financial, economic, management, human resources and engineering skills,

Each interview lasted on average 2 hours, after they were conducted, they were analyzed based on the theoretical framework.

## 4. DATA ANALYSIS

After data collection through semi-structured interviews, it was found that the dimensions to be suggested for the metric of non-financial indicators that would include the areas involving the links of the main and auxiliary chain are respectively: environmental, economic, social, trust and cooperation. Table 2 shows the dimensions with their respective basis of literature.



Table 2 - Dimensions and basis of literature

Dimensions	Basis of Literature
Environmental	Delai; Takahashi, 2008; Grahn, 2020.
Social	Delai; Takahashi, 2008;
Economic	Delai; Takahashi, 2008;
Cooperation	Miotti; Sachwald, 2003;
Trust	Lundasen, 2002; Zanini; Migueles, 2014;

From this definition of the dimensions it becomes feasible to research the indicators and themes to be worked on each of the five listed in the table above.

#### 4. CONCLUSION

There is no consensus on the definition of non-financial gains, non-financial indicators, their dimensions and the resulting causal relationships in productive chains. The development of indicators becomes complex because the empirical research activity confronts concepts that paradoxically differ from metrics. This work contributes to the discussion being applied to productive chains with the objective of measuring activities and the sustainability of their links.

This study sought to define dimensions, themes and variables where they could direct the analysis of the sustainability of the production chain, as well as the organizations that depend on them, which carry out imputability and exit, in addition to helping to identify links with gaps and thus balance the chain, which can impact on credibility and sustainability.

#### REFERENCES

- ARCAS; N., RUIZ, S. Commercialization and performance of co-agents fruits and vegetables, *Revista de Estudos Cooperativos*. 36.1, 22-44. 2003.
- ASHKENAS, R.; ULRICH, D.; JICK, T.; KERR, S. *Organização Boundaryless: Breaking the chains of the organizational structure*, Jossey-Bass, 1995.
- BOYD, S.; BOLAND, M.; DHUYVETTER, K.; BARTON, D.  
Determinants of Return on Equity in Local US Cooperatives Supply and trade in agricultural grain. *Journal of Agricultural and Applied* 39. 2007.
- BROWN, A.D.; HUMPHREYS, M.; GURNEY, P.M. Narrative, identity and change: a Laskarina Holidays case study. *Organizational Change Management Journal*, 18 (4), pp. 312-326. 2005.

CARSON, D.; GILMORE, A.; PERRY, C.; GRONHAUG, K. Marketing qualitativo Pesquisa. Estados Unidos: SAGE Publications. 2001.

CHEN, K.H.; SHIMERDA, T.A. Uma *análise* empírica de índices financeiros úteis. *Gestão Financeira* 10, 51-60. 1981.

CHONG, H.G. The performance of small and medium-sized measurement companies: the grounded theoretical approach, *Journal of Business and Public Affairs*, 2008.

CIMA. A Medição de Desempenho no Setor Manufatureiro. Londres: CIMA. 1993.

Cho, H.J.; Pucik, V. 2005, *Relationship between innovation, quality, growth, profitability and market value*, in: *Strategic Management Journal* (26). Denzin NK e Lincoln YS (eds.) 2000, *Manual de Qualitativo*, 2<sup>nd</sup> Edn. 2005.

FERRIER, G.D.; PORTER, P.K. A eficiência produtiva dos co-agentes de processamento de leite dos EUA, *Journal of Agricultural Economics*, 42, 2, 161-74. 1991.

Fisher, J. 1992, Uso de medidas de desempenho não financeiro. *Journal of Cost Management*, 6 (1), 31-38. 1992.

FITZGERALD, L.; JOHNSTON, R.; BRIGNALL, S.; SILVESTRE, R.; VOSS, C. Performance Measurement em empresas de serviço, CIMA, da Black Bear Press Ltd. King Hedges Road, Cambridge. 1991.

GARENGO, P.; BIAZZO, S.; BITITCI, U.S. Sistemas de Medição de Desempenho em PMEs: Uma Revisão de uma Agenda de Pesquisa. *International Journal of Management Reviews*. 7(1), 25-47. 2005.

GRAHN, A. Precision and Manipulation of Non-Financial Information: The Curious Case of Environmental Liability. Abacus published by John Wiley & Sons Australia, Ltd on behalf of Accounting Foundation, The University of Sydney. 2020.

HASHIM, M.K. Small and medium-sized companies in Malaysia for: challenges in a new economy. Sintok: UUM Press. 2005.

Haskett, A.J.; Dixon, J.R.; Vollmann, T. E. Strategic Control and Performance Measurement, *Journal of Cost Management*. 1994.

Holme, J.M.; Solvang, BK 1997. *Research Method - on qualitative and quantitative method*, Literatura

Estudantil, Lund. 1997.

Hudson, M.; , Elegant, A e Bourne, M 2001', theory and practice in the performance of measurement systems de PME: *International Journal of Operations & Production Management*, 21 (8), 1096-1115.

Jarvis, R, Curran, J, Kitching, J.; Lightfoot, L. The use and quantitative qualitative criteria in measuring performance in small enterprises. *Journal of Small Business and Enterprise Development* , 7 (2), pp. 123-133. 2000.

Jensen, M.C. A Theory: Governance, Residual Rights, and Organizational Form, Harvard University Press. 2003.

JEAN, L. The narrative addresses the transfer of organizational knowledge. *Research Knowledge Management and Practice*, 2 (3), 184-193. 2004.

KAPLAN, R.S.; NORTON, D.P.; 2000 a Focused Organizational Strategy: How balanced scorecard companies thrive in the new business environment: Harvard Business School Press, Boston, MA. 2000.

Kumar N.; Scheer, L.K.; Achrol, R.S. Avaliação de Desempenho do Revendedor de Perspectiva de Fornecedores: *Journal of Marketing Research*, 29, 238-53. 1992.

Langfield-Smith, K, Thorne, H e Hilton, RW 2003, *Management Accounting: In the Australian Perspective*, 3rd Edition, McGraw-Hill, Austrália.

Lincoln, Y e Guba, E 2000, qualitative researcher's partner. *Jornal de Gestão* 23 (3), 409-473

Lindsay, E 2012, PIB malaysia driven mainly by services, manufacturing sectors. Borneo Post, por, emylindsay@theborneopost.com. Postado em 20 de abril de 2012,

[http://www.theborneopost.com/2012/04/20/malaysias-gdp-driven-mainly-by...setores de serviços de fabricação /](http://www.theborneopost.com/2012/04/20/malaysias-gdp-driven-mainly-by...setores-de-serviços-de-fabricação/) accessed December 10, 2019.

Luther, C, Fortuin, G e Wouters, M 2005, " *Designing a System Performance Measure: A Case Study* ". *European Journal of Operational Research* , 156 (2), 267-286.

Matsumoto, K, Shivaswamy, M e Hoban, JP Jr 1995. Security analysts of the financial indexes of factories and retail", *Financial Practice and Education* 5, 44-55.

Mohd Harif, MAA 2001, financial planning for the creation of a new franchise system in Malaysia: An action research study, "doctoral role in philosophy at the Faculty of Business and Trade university do Sul de Queensland Toowoomba, Austrália.

Mohd Harif, MAA, Harizal e Hoe, CH 2010, "*Financial Management Practices: An In-Depth Study among the CEOs of Small and Medium Enterprises (SMEs)*", *International Review of Paper Business Research*, Volume 6. Número 6. pp.13 – 35 Moyano J. e Fidalgo FA 2001, *O impacto da dimensão cooperativa*, (REVESCO), 73, 95-121.

Neely, A, Gregory, M e Platts, K 1995, " measurement system project: a review of the literature and research agenda ", *International Journal of Operations and Production Management*, vol. 15, N° 4, pp. 80-116.

Neely, The 1999, "*The Performance Measurement Revolution: Why Now and What Comes Next*" *International Journal of Operations & Production Management*, 77 University of Cambridge, Uk: MCB University Press, Vol. 19, No. 2, pp. 205-228.

Neely, A, Adams, C and Kennerley, M 2002, *Prism Performance-EGR to measure and manage business success*. Prentice-Hall, Englewood Cliffs, Nj.

Parker, R 2000 "small is not necessarily pretty: an assessment of political support for small and medium-sized enterprises in Australia," *Australia Journal of Political Science*, Vol. 35 (2), 239- 415

Perera, S and Baker, P 2007, 'Performance Measurement Practices in Small and Medium-Sized Manufacturing Companies in Australia, *Small EnterpriseResearch*, Vol. 15, N°2, 10-30.

Sherman, A and Bohlander, G 1992, *human resources management* (Ninth Edition).

Cincinnati, OH: Southwestern Publishing Co. St-Pierre, J and Delisle, 2006 S "A Specialized Diagnostic System for the Comparative Assessment of Performance of SMEs", *benchmarking: An International Journal* ., 13, 1/2, pp 106-119 Sun, J, and Li, H 2006, mining method data for financial distress of listed forecasting companies , knowledge-based systems, sent on December 8, 2006. [www.Scinedirect.com](http://www.Scinedirect.com)

Sun, PY and Scott, JL 2003 "Towards a Better Measurement of Qualitative Performance in Organizations", *by the learning organization*, Vol. 10 No. 5, pp. 258-271.

Svenning, MM 2003 "Ethical considerations in qualitative research", *Western Journal of Nursing Research* , 10 (2), 150-162.

Taticchi, P, Cagnazzo, L and Botarelli, M 2008, *and Performance Measurement*

Management (PMM) for SMEs: literature review and reference for pmm project. POMS 19th Annual Conference La Jolla, California, U.S. May 9, May 12, 2008

Webb, D., Greatbanks, R., Hough, J. 1999, "A basis for improving measurement performance in industrial SMEs" : Proceedings 2nd International Conference on the Promotion of Manufacturing Excellence in SMEs (Plymouth: University of Plymouth), pp. 201-210.

WEBSTER, F.E. Jr. Change in the Role of Marketing in the Corporation." *Daily Marketing*, Vol. 56, Issue 4, pp. 1-17.1992.

ZAIRI, M. 1993, "Application of a desemp measure

# **INLET CROSSING INSPECTION IN URBAN WAY BASED ON ROAD SAFETY FACTORS.**

**Irauna Maicon Rodrigues de Carvalho**

Civil Engineer, Federal Institute of Amazonas (IFAM)

Única University

iraunaaa@gmail.com

**Luiz Mauro Brandolt**

Civil Engineer, Federal Institute of Amazonas (IFAM)

maurobrandolt1995@hotmail.com

**Átila Sielskis Vieira Ermes**

Civil Engineer, Federal Institute of Amazonas (IFAM)

atilasielskis13@gmail.com

**Juliana Christine da Silva Granja**

Unyleya University

Juliana.chirstyne2@gmail.com

## **Abstract**

*The reference object is located on two arterial avenues making the bridge for pedestrians to use bus lines from diferente urbana áreas. Bus terminals offer the option for passengers to use lines to different areas of their origin, in the city of Manaus there are some bus stops that perform this function, and the crossing under review is the tool that makes this connection between the places. Through Geographic Information System (GIS) tools and Traffic Agency data, the goal is to show that such a crossing does not serve the entire population.*

**Key-Words:** Securite Traffic. Walkability, Manaus City.

## **1. Introduction**

The city of Manaus has a little more than 2 million inhabitants, and not so far from the great metropolises of Brazil, it faces major problems in urban mobility. Traffic in the capital city is growing exorbitantly, the ease of buying and selling motor vehicles has gradually added to traffic in the city. The lack of efficiency in the inspection of Organs competent bodies regarding the traffic of vehicles is also one of the factors that associate difficulties in traffic, but the biggest problem that generates a restriction in the improvement of



traffic is the scarcity of the applicability of research projects in the main urban roads. regarding the fluidity of motor vehicles.

Being run over, in addition to harming the health of those involved, this when they are not fatal, generates disorders in the roads and expenses to the public power. It is noteworthy that, they happen mainly during the attempt of crossing the pedestrian, but they can happen while walking, or even are stopped, by the track or sidewalk. According to GOLD (1998), crossing conditions, which are a function of traffic engineering and the behavior of drivers, must be analyzed through the ease with which pedestrians cross the street without coming into conflict with vehicles.

The objective of the Urban Bus Terminal is to be a place of choice for the user of public transport of bus routes to different areas from their origin to another. In Manaus, not all bus lines follow a route to the passenger's final destination, right in the capital of Amazonas there are 5 terminals that perform this function for the user, terminal 1 is located in the central region, terminal 2 in the south of the city in neighborhood of Cachoeirinha, terminal 3 in the North zone in the neighborhood of Cidade Nova, terminal 4 on the border between the north (Bairro Cidade Nova) and east (Bairro Jorge Teixeira) and terminal 5 on the east side in the Zumbi dos Palmares neighborhood. However, for some pedestrians, there is the advantage and agility of making the alternative from the route of origin to the final destination, alternating at stops, for users who use electronic ticketing is a great advantage, since the use of the card gives the user the advantage of have a period of 30 minutes to change from one bus to another without a new payment. In the analysis of the object of study, we selected the uneven crossing of Carrefour das Flores as the interconnection of this type of alternative to the user, however it is not a crossing with accessibility for all users.

According to the DNIT's Special Works Project Manual, the walkways are special works of art intended essentially for pedestrian traffic and, eventually, for cyclists; whenever the importance of separating vehicle traffic from pedestrian crossing grows, increasing pedestrian safety and facilitating traffic flow, it is necessary to build a walkway.

Also according to the DNIT Manual, the catwalks in the project design must be considered in the requirements of ABNT NBR 9050 - Accessibility for People with Disabilities to Buildings, Furniture Space and Urban Equipment. The walkway in question belongs to the requirements of the standard, of the type above the superstructure of the permanent road defined by overlying walkways, since they can be designed in the open or covered, by reinforced concrete slab, or other material, for protection against weather.

Extensive networks of circulation structures internally connect urban agglomerations interconnecting the landscape and forming the systems that represent an important part of the built environment. Accessibility to this system is an essential condition for all individuals to enjoy urban spaces with adequate mobility. And, this being the result of the interaction between the displacement of people and goods with the city, observing and favoring these displacements becomes an important object of investigation (BRASIL, 2004). Accessibility can be understood as the possibility and condition of reach, perception and understanding for the use, with security and autonomy, of spaces, furniture, urban equipment, buildings, transport, information, communication, including its systems and technologies, as well as other services and facilities open to the public, for public or private use for collective use, both in urban and rural areas, by people with disabilities or reduced mobility (ABNT, 2015).

The discussion about the conflict between accessibility versus urban infrastructure has intensified in the era of social media. In 2012, Law No. 12,587 was enacted, which institutes the guidelines of the National Urban Mobility Policy, bringing conceptually in its Article 4 urban mobility as the condition in which the displacement of people and cargo in the urban space takes place. Accessibility as the facility made available to people with autonomy in the desired trips, respecting the legislation in force. The law adopts universal accessibility as one of its principles (Art. 5 of section II) and aims (Art 7 of section II) to reduce inequalities and promote social inclusion and provide improvement in the urban conditions of the population with regard to accessibility and mobility (BRASIL, 2012).

Based on bibliographic references in the definitions of unevenness and accessibility crossings, on-site analyzes of the object of study were made and transformed into a tool in the referred research.

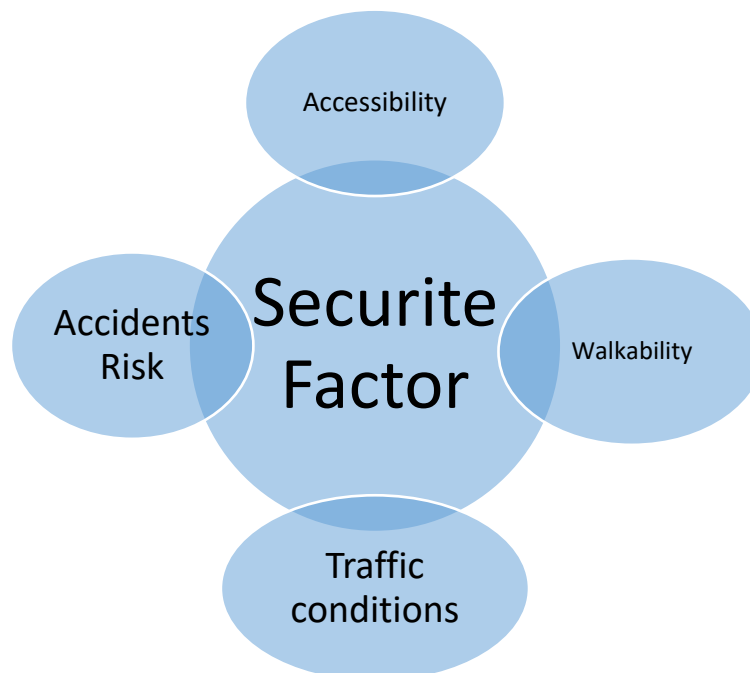
## 2. Metodology

The walkway is located between the end and the beginning of two main high-flow avenues in the city, Avenida Djalma Batista and Avenida Torquato Tapajós. Three PGV's are located in its vicinity: the Tropeiro grill, the Carrefour supermarket and the Ciesa University, which possibly leverages the flow of users of the walkway.

The analysis will be made with assessments of the conditioning factors of safety factors in the current offer of the walkway with on-site visit and with pertinent information on the routes in the Urban Mobility plan of the City.

The conditions that make up the safety factor are expressed according to flowchart 1.

Flowchart 1. Securite Factor.



The conditions that make up the safety factor have been inspected according to the principles of the user's needs.

As for the defined conditions, Table 1 defines the conditions according to the degree of offer favorable to users, following the methodology adopted by Prof. Dr. Hugo Pietrantonio.

Table 1- Safety factors in a current and future offer. Source: Own.

Degree of offer to the user	Safety factor in the current catwalk scenario	Degree of offer to the user	Safety factor in a future scenario with the renovation of the catwalk
3	Comfort	4	Comfort
2	Accessibility	5	Accessibility
3	Walkability	4	Walkability
4	Traffic Conditions	4	Traffic Conditions
2	Accidents Risk	1	Accidents Risk

For the understanding to be made, the degree of supply will take place in 5 levels, with 0 to 2 being an unfavorable safety factor, 3 an intermediate environment and 4 to 5 being an environment-friendly safety factor

The assertion of the degree of security of these factors will occur with the analysis of the data of the current scenario and the prognosis of the future scenario with the necessary adjustments.

### **Current Scenario**

- **Comfort:**

The user needs to have good physical conditions to climb the inclined stairs, and the city's climate is not conducive to aerobic exercise. The walkway coverings and painting recently have a tone of good energy for the pedestrian.

- **Accessibility:**

The individual who has physical and visual disabilities is unable to enjoy the walkway, the infrastructure completely excludes this population.

- **Walkability:**

The width of the walkway is narrow, users who travel in opposite directions are obliged to have preference for one of both directions. At night, the lighting it has has no efficacy to illuminate the entire path.

- **Traffic Control:**

Users who transit at peak times are obliged to reduce their steps due to the catwalk not being able to accommodate everyone due to its narrowing.

- **Accidents Risk:**

Users who are excluded from using the walkway need to cross the avenue, putting their physical integrity at risk.

### **Boulevard**

According to the data in volume 1 of the Urban Mobility Plan of the city of Manaus 2015 developed by the company Oficina Consultorias, we have the data treated in the simulation of the transport network for the

individual motorized mode in the current offer scenario at the peak hour of the morning of the flow of vehicles in both directions of the avenues that house the crossings according to Table 2.

Table 2. Flow of vehicles in both directions. Source: PlanMob 2015, Volume 1.

<b>Boulevard</b>	<b>Direction</b>	<b>2015</b>	<b>2020</b>	<b>2025</b>	<b>2030</b>	<b>2035</b>
Djalma Batista	Downtown - Neighborhood	1.828	1.528	1.612	1.572	1.595
Torquato Tapajós	Neighborhood - Downtown	2.353	2.629	2.816	2.885	3.023

It is noticeable the large flow of vehicles in this region, the forecasts of the following years tend to gradually increase in the neighborhood-center direction while the other way undergoes an oscillation. The demand for the number of passengers at the Avenida Torquato Tapajós bus stop may be higher than that of the other route.

According to the Mobility Plan report, Avenida Torquato Tapajós is used as part of the route of an expressive number of damaged typology lines that serve the North, West and Northeast regions, resulting in a frequency of 146 Buses / hour in the section greater vehicular flow. On Avenida Djalma, there is a strong presence of commercial activities, and therefore constitutes a pole of attraction for specific trips, which leads to the existence of numerous bus lines.

### **Accidents**

The main function of uneven crossings is to make the crossing safe for the user, in this aspect according to table 1, it is possible to visualize the high accident rate that both avenues that house the walkway present.

Table 3. Road accidents.

<b>Boulevard</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>Total</b>
<b>Torquato</b>	21	31	32	26	24	43	<b>177</b>
<b>Tapajos</b>							
<b>Djalma Batista</b>	15	16	16	26	17	19	<b>109</b>

The information contained in table 3 was taken from data provided by ManausTrans, it is the 10 avenues with the highest number of accidents in Manaus, however for research analysis only those that segregate the walkway were emphasized, it was possible to evaluate that Avenida Torquato Tapajos presents an unpleasant number of accidents per year, where its highest rate was in 2016 and Avenida Djalma Batista in 2014.

### **Localization**

Pictures 1,2 and 3 show the condition of the current catwalk scenario, it is notable that the catwalk undergoes some renovations in part of its infrastructure.



Figure 1. Location of the crossing. Source: Google Earth Pro.

As shown in figure 1, the walkway is approximately 102 meters long, with two accesses on both avenues. In image 2 it is possible to analyze the walkway in another perspective of access, made the analysis through another angle it is possible to make the necessary necessary recommendations later.

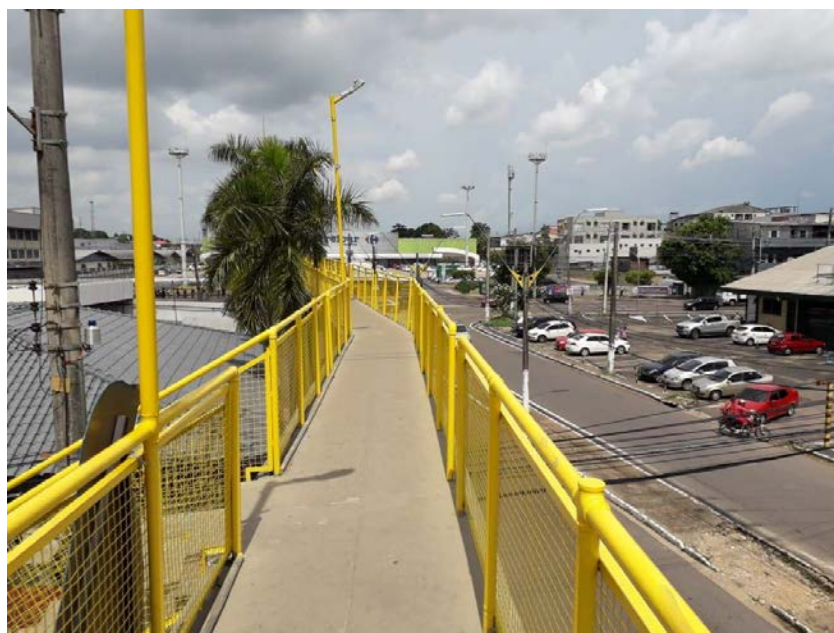


Figure 2. Footbridge. Source: Own.

Recently, some repairs were made to the painting and lighting of the walkway, the visual generated a positive visual impact because with the painting it was possible to give the user a safe form of handholds on the handrail, which was previously unusual due to the irons being, in their greatest long, rusty.





Figure 3. Footbridge. Source: Own.

According to image 3, traffic between users is restricted along their path, as its width is very narrow (less than one meter wide) and users who cannot have the privilege of using the walkway must cross with motorized vehicles, in this case the visually impaired mostly, await other users to assist them in maneuvering up and down stairs.

In Manaus, some walkways are distinguished by good accessibility, a few kilometers from the object of study, the walkway that connects a bus stop to a shopping center, accessibility was valued differently, elevators were not installed, but wide corridors were made, as shown in image 4.



Figure 4. Footbridge Amazonas Shopping. Source: Acritica.com

In the capital of Amazonas, there are few walkways that serve the entire community, on Avenida Torquato Tapajós recently installed one near a club, excluding the physically and visually impaired. The authorities do not realize the need to serve the entire community. The number of walkways with nearby



PGV's that serve all communities are few, from an analysis carried out on the spot it is estimated that only that of Amazonas shopping, shopping manauara and shopping ponta negra (Main) are the ones that serve everyone.

### 3. Results

As a result, some notes were cataloged, with an opinion poll (16 people were consulted on the spot), with scores from 5 to 10 to assess the crossing studied.

Table 04. Conclusion Opinions.

Indicator	Note	Observation
Comfort	6,5	It has no cover, and the crossing is narrow. The painting presents a tone of good energy to the pedestrian.
Acessibility	6,0	It does not present instruments for people with physical and visual disabilities (such as podotactil or directional floors) to use the walkway more safely.
Walkability	6,0	Walkway is narrow. Lighting that it has, has no efficacy to illuminate the entire path.
Traffic Control	6,0	At peak times, users are forced to reduce their steps due to the walkway being unable to accommodate several people due to its narrowing.
Accidents	6,0	There is no elevator for PCD, users who are excluded from using the footbridge need to cross the avenue.

The walkway was considered average by users. A study can be redone by the IMMU by repairing the main problems faced by users.

### 4. Conclusion

Urban mobility must not, by law, restrict pedestrian traffic of any race, ethnicity, culture, origin, handicap and community. The metropolis of the state of Amazonas, erroneously, is excluding people with visual and physical disabilities in not adapting such needs in the infrastructure of walkways close to PGV's.

It is noticeable that this North-South Axis - formed by the avenues Djalma Batista and Mário Ypiranga - divides the city into two little integrated portions as described in the Manaus Mobility Plan. This is usually occurring because there are very few points of transposition of these routes. There are not enough pedestrian crossings and pedestrian crossings and even from the point of view of motor vehicle traffic, there are few options of roads that cross it.

Recently, the city government announced a package of works with revitalization of more than 20 walkways, however these reforms do not provide for adjustments in the constructions regarding the width, ramps or facilities for PCD elevators.

The safety factors of the current scenario reveal in another form of perception that the user with special needs is unable to use a public urban heritage due to the lack of adequate infrastructure. In order to improve infrastructure in the future scenario, there must first be awareness of the government towards the PCD community. Elevator installations are the best way of renting the walkway, as the space is not conducive to making ramps, improvements in lighting, it will also be necessary to increase the length and width, make installations in strategic places of devices that emit sounds indicating the direction that the visually impaired must follow to make the crossing safely.

With the analysis of on-site visits, reading of construction codes, interviews with local users of the walkway, analysis of road data, analysis of accidents and road flows, it is possible to mention that the main problems presented by the walkway are:

- Exclusion of physically disabled people, in particular to PCD's.
- Partial exclusion of visually impaired people.
- Poor traffic by users due to its narrow width.
- In a future scenario, there will be conflict in the trafficability of PCD's that are in opposite directions.
- Low light illumination.
- Very steep stair slope, making users physically fit.

With the reported difficulties, it is advantageous for the population that the competent bodies do not just make basic reforms, and redo a drastic assessment of the walkway analyzing all its infrastructure and accessibility to everyone in the place.

## **5. Acknowledgement**

We first thank God for giving us strength and the Federal Institute of Education, Science and Technology of Amazonas for providing us with the appropriate infrastructure for carrying out research. We thank Professor Dr Jussara Socorro Cury Maciel for encouraging students to conduct research and Professor Marcos Rayker for indicating the platform!

## **6. References**

ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. NBR 9050: Acessibilidade a edificações, mobiliário, espaços e equipamentos urbanos. Rio de Janeiro: ABNT, 2015. Disponível em: [http://www.pessoacomdeficiencia.gov.br/app/sites/default/files/arquivos/%5Bfield\\_generico\\_i\\_magens-filefield-description%5D\\_164.pdf](http://www.pessoacomdeficiencia.gov.br/app/sites/default/files/arquivos/%5Bfield_generico_i_magens-filefield-description%5D_164.pdf)

BRASIL. Política Nacional de Mobilidade Urbana Sustentável: Princípios e Diretrizes Aprovadas no conselho das cidades em setembro de 2004. Secretaria Nacional de Transporte e Mobilidade Urbana. Ministério das Cidades, Brasil: 2004

Brasil Acessível: Programa Brasileiro de Acessibilidade Urbana - Caderno 2: Construindo a cidade acessível. Secretaria Nacional de Transporte e da Mobilidade Urbana, Ministério das Cidades, Brasil: 2006. Disponível em <<http://www.cidades.gov.br>>. Acesso em: 05 de Outubro de 2019.

GOLD, Philip Antony. Segurança de trânsito – Aplicações de Engenharia para reduzir acidentes. Estados Unidos da América, 1998;

Manual de projeto de obras-de-arte especiais - Rio de Janeiro, 1996. 225p. (IPR. Publ., 698).

Plano de Mobilidade Urbana de Manaus – Manaus, 2015, vol I.

### **Copyright Disclaimer**

Copyright for this article is retained by the author: IRAÚNA MAICONA RODRIGUES DE CARVALHO, LUIZ MAURO BRANDOLT, ÁTILA SIELSKIS VIEIRA ERMES and JULIANA CHRISTINE DA SILVA GRANJA with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

## **Diagnosis of hollow trees in an area of effective sustainable forest management in the Amazon forest**

**Suzana Helen da Silva Medeiros**

Universidade Federal do Amazonas

**Claudete Catanhede do Nascimento**

Instituto Nacional de Pesquisas da Amazônia

**Bruno Rodrigues Oliveira**

Universidade Federal do Amazonas

**Marcos Antonio Silva de Souza**

Universidade Federal do Amazonas

**Fernanda Barbosa Barros**

Universidade Federal do Amazonas

### **ABSTRACT**

*The sustainable practices of Forest Management activities are used with the objective of minimizing impacts to the environment, as well as exploring tree individuals with qualities that aim at the highest volumetric yield in sawmills. However, some characteristics may not be diagnosed before logging, as is the case with hollow trees, commonly found in forested areas. Thus, the objective was to diagnose the occurrence of hollow trees in two areas of forest exploitation, for the knowledge of individuals at the family and botanical species level. In order to carry out the diagnosis of the occurrence of hollow trees, data on the effective exploitation of trees in the Company's Forest Management areas were obtained through a collection of information on two Annual Production Units - UPA, named according to the company's specification as named as UPA ITP11 and UPA FLA01. In each UPA, tree individuals were identified by gender, species, family, distribution, presence of hollowness and the basic density of their wood. The results show that in the UPA ITP11 area, 7.38% of the total trees explored, had hollowness, while in the UPA FLA01 area it was 4.88% and that the majority had high basic density. Twenty botanical families were identified in the exploration areas, where the Leguminosae family obtained the greatest representation. A total of 49 botanical species explored were identified, being *Manilkara huberi* (Ducke) Stanley, as basic high density wood. Regarding the frequency of occurrence of hollowness, the species *Dinizia excelsa* Ducke, popularly known as *Angelim Vermelho*, stood out for the two areas under study. However, it is shown the considerable existence of hollow trees among the trees selected for forest exploitation, reinforcing the importance of better targeting of appropriate methodologies for their*

*identification, as well as, the better volumetric utilization of logs in sawmills, in order to certify the sustainability for the activity, regardless of the structural aspect of forestry individuals.*

**Keywords:** Hollow tree, tropical woods, forest management, volumetric use.

## INTRODUCTION

The Amazon rainforest is the largest tropical rainforest, occupying approximately 6 million km<sup>2</sup>, with complex characteristics, both environmental and socio cultural (BRAZ et al, 2014). The Brazilian legal Amazon corresponds to more than half of the national territory (LIMA; SANTOS; HIGUCHI, 2005), having a role as a climate regulator, providing environmental services and carbon storage (PEREIRA, 2010).

With the industrialization of lumber, the activity has become one of the three main economies of the States that the Amazon region covers (PEREIRA, 2010). Such potential valuation of timber species also encourages the illegal exploitation of this raw material in the region, contributing to high rates of deforestation, as pointed out by Imazon's Deforestation Alert System - SAD (2019), which only between January 2018 and January In 2019, there was a 54% increase in deforested areas in the Legal Amazon.

It was from the constant increase in deforestation in the region that solutions are constantly being created to combat and reduce illegal deforestation in the Amazon. Among the solutions, the importance of sustainable forest management was highlighted, which, according to Braz et al. (2014), has the duty to combat irrational and illegal logging, in addition to fostering development strategies.

However, the exploration of native forests becomes an imprecise activity regarding the conditions of the raw material, since the environment is in charge of constant ecological changes, giving characteristics to forestry individuals, which for industrial interests, do not become economically viable. Among these characteristics, the occurrence and, consequently, the cutting of hollow trees is common. This, since the technique, popularly known as “hollow test”, is outdated to accurately distinguish the occurrence of hollowness in the tree (Eleutério, 2011), this identification being made only on the basis of the tree's stem, erroneously excluded the possibilities of hollowness being present along the shaft.

Currently, loggers have only empirical knowledge of the possibility of the hollow in the tree for some species of commercial interest. However, studies related to the main tree species with occurrence of hollowness are still rare, this knowledge being essential to the wood processing industries, since trees with hollowness have difficulty at the time of cutting. Thus, the objective was to carry out a diagnosis of the occurrence of hollowness, of the main forest species exploited for timber consumption, in a forest management carried out in the Amazon region.

## MATERIAL AND METHODS

### - Characterization of the study area

The study focused on the municipalities of Itapiranga and Silves in the state of Amazonas in areas of effective Sustainable Forest Management at Empresa Mil Madeiras Preciosas Ltda, located in the

municipality of Itacoatiara at the following coordinates, 3°3'14.54" to the south and 58°43 '39.85" to the West.

### - Diagnosis of hollow trees in Forest Management areas

In order to carry out the diagnosis of the occurrence of hollow trees, data on the effective exploitation of trees in the Company's Forest Management areas were obtained. The study sought information that could certify the presence of hollow trees in native Amazonian forests, for this, a collection of information was obtained about two Annual Production Units - UPA, named according to the company's specification as ITP11 and FLA01. Among the information, data related to the pre-exploratory and post-exploratory forest inventory were gathered as a basis used to determine the diagnosis, according to the criteria and limits established by the company and legislation for the exercise of the activity.

Figure 1 shows the spatial location of the two UPAs, sources of information used in the study. The UPA called IPT11 is located in the municipality of Itapiranga and has an area of 7,164.56 hectares, whereas the UPA FLA01, in the municipality of Silves, has an area of 7,925.81 hectares. However, the area of effective exploitation of sustainable forest management excludes areas of permanent preservation of water bodies and restricted use, thus reducing the exploitable areas of the two Annual Production Units.

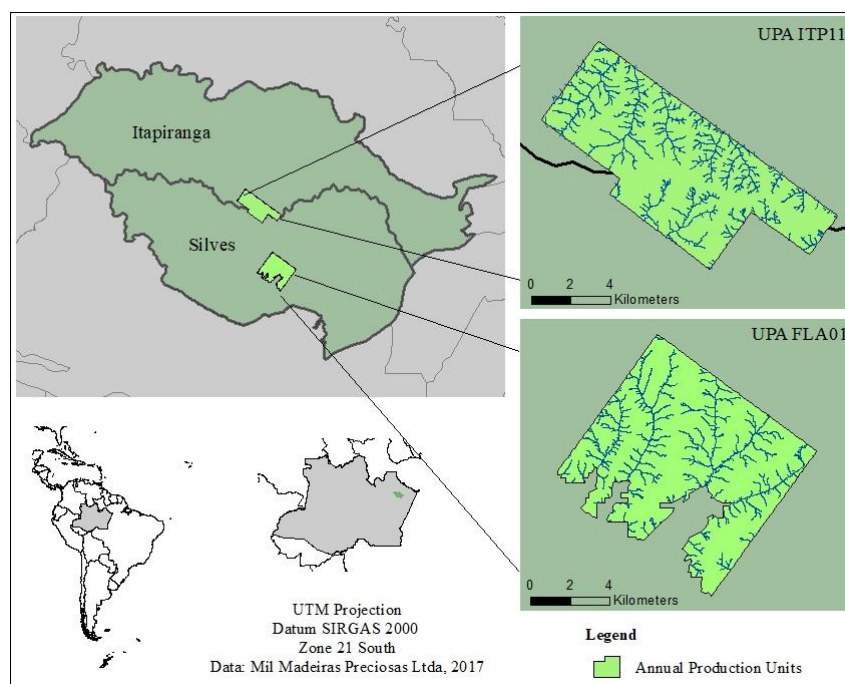


Figure 1. Location of Annual Production Unit areas, sources of study data.

The company's sustainable forest management practices begin with the work of georeferencing and macro zoning of forest areas. Subsequently, the Forest Inventory is carried out through the registration and identification of trees of potential current and future commercial value, with a diameter (DBH) from 40 cm. After mapping the environmental conditions of the management area, exploration and legal control of forest production is carried out. In the exploratory phase, directional cutting techniques are applied to the selected trees, carrying out their pre-dragging and dragging, with techniques that aim at minimum changes



in the edaphic conditions of the area, favoring the regeneration of the forest after the first cutting cycle management.

After cutting each individual tree, the company performs the cubing in order to measure the volume of wood harvested. With this, it was possible to carry out the identification of the existence of hollowness in the shaft of the trees explored at the Annual Production Units under study and the density of the wood.

### - Frequency of hollow trees

The total number of trees explored by species was counted, with the respective number of hollow trees found, for each UPA. In addition, an added information in this analysis was the verification of the basic density of the species, since this parameter is also identified as an identifier of possible hollow individuals.

Thus, the diagnosis allowed the recognition of individuals at the level of family and botanical species. Subsequently, the frequency count of occurrence of trees with the presence of hollowness in the shaft by species was made, according to Equation 1.

$$f_{oca} = \frac{AO}{n} \times 100 \quad \text{Equation 1}$$

Where:

$f_{oca}$  = frequency of occurrence of trees with hollow (%);

AO = number of hollow trees recorded during the cutting operation;

n = total number of trees explored.

### - Data analysis

The information was obtained based on the diagnosis of the trees, frequency and distribution of the hollow trees taking into account the family, the gender of each tree and the density.

## RESULTS AND DISCUSSION

### - Diagnostics of hollow trees

The forest inventory carried out in the area of UPA ITP11 registered a total of 95,177 trees, while in the area of UPA FLA01, 85,657 trees were inventoried. At UPA ITP11, 20,897 trees were harvested for timber purposes, about 21% of the total number of trees inventoried. At UPA FLA01, 26,122 trees were explored, corresponding to 30% of the total trees inventoried in this area.

With the survey, 1,543 trees were identified with the presence of void in the shaft for the area of UPA ITP11 and 1,277 hollow trees for the area of UPA FLA01, representing about 7.38% and 4.88% of the total hollow trees explored respectively for both areas.

Other authors have also investigated the occurrence of hollow trees, such as Minetti et al. (2000) in a study carried out in the municipality of Itacoatiara-AM, detected about 23% of the total of trees explored were hollow. While Medeiros (2013) identified 16% of hollow trees in an INPA / ZF2 experimental area with impulse tomography. For the authors, the presence of the hollowness confers both the low volumetric

yield and the low productivity of the forestry activity, making it a matter of concern to the timber companies.

In the diagnosis made by Emmert (2014), in areas of private forest (Municipality of Itacoatiara-AM) and public forest (FLONA do Jamari-RO), the equivalent of 17 of the total of trees included in the exploration planning were registered, 1% and 6.7% of hollow trees, respectively. In a more recent study by Almeida (2018), carried out at FLONA Saracá-Taquera-PA, 533 hollow trees were diagnosed in a forest exploitation area, representing the equivalent of 17% of the total of trees explored.

It is shown, therefore, that there is a large representation of hollow trees in native forest areas in the Amazon region, which can negatively interfere in the planning of exploration projects. Thus, maintaining or cutting hollow trees is an issue that involves ecological and economic implications. From an ecological point of view, the exploration or not of hollow wood would provide benefits to the forest such as the genetic improvement of species, contribution to environmental services, in addition to the shelter of small animals. From an economic point of view, it is important to consider the high costs of exploration per individual tree, the low volumetric yield of hollow logs, in addition to the uncertainty of logs usable for commercialization (Eleutério, 2011, Danielli, 2013).

The total information of the standing trees has not become a reliable parameter since the hollow test, the method to which the chainsaw saber is inserted in the shaft of the trees for such identification, is considered outdated, since the test is performed only on base of the tree, and the hollowness can occur along the entire shaft.

#### - Frequency and distribution of hollow trees in management areas

From the information obtained on the forest exploitation of the management areas, a total of 20 botanical families and 49 forest species were gathered for the two areas under study (Table 1).

**Table 1.** Trees explored in forest management area, with occurrence of hollowness.

Common name	Scientific name	Botanical Family	Db (g.cm <sup>3</sup> )	ITP11		FLA01	
				Arv exp	Hollow arv	Arv exp	Hollow arv
Maçaranduba	<i>Manilkara huberi</i> (Ducke) Standley	Sapotaceae	0.92	2,368	533	1,672	319
Black Laurel	<i>Ocotea neesiana</i> (Miq.) Kosterm.	Lauraceae	0.63	2,455	303	2,522	200
Louro-itauba	<i>Mezilaurus itauba</i> (Meissn.) Taub. ex Mez.	Lauraceae	0.8	826	157	73	9
Red Angelim	<i>Dinizia excelsa</i> Ducke	Leguminosae	0.83	85	29	327	132

Pequiá	<i>Caryocar villosum</i> (Aubl) Pers	Caryocaraceae	0.63	199	54	355	80
Cumarú	<i>Dipteryx odorata</i> (Aubl.) Willd.	Leguminosae	0.97	518	42	727	71
Amapá	<i>Brosimum</i> <i>parinarioides</i> Ducke	Moraceae	0.57	616	32	1,720	62
Cupiúba	<i>Goupia glabra</i> Aubl.	Celastraceae	0.69	797	38	1403	50
Louro-gamela	<i>Ocotea rubra</i> Mez	Lauraceae	0.58	1,670	61	171	2
Uxi	<i>Uchi endopleura</i> (Huber) Cuatrec.	Humiriaceae	0.78	390	17	1215	44
Red Pitch	<i>Protium</i> <i>puncticulatum</i> Macbr.	Burseraceae	0.63	2,176	40	88	4
Yellow Sucupira	<i>Enterolobium</i> <i>schomburgkii</i> (Benth.) Benth.	Leguminosae	0.84	200	8	903	30
Jatobá	<i>Hymenaea</i> <i>courbaril</i> L.	Leguminosae	0.76	45	3	451	33
Castanha- sapucaia	<i>Lecythis zabucajo</i>	Lecythidaceae	0.84	485	35	0	0
Brindle Angelim	<i>Pithecellobium</i> <i>incuriale</i>	Leguminosae	0.81	263	9	714	24
Red Arurá	<i>Iryanthera</i> <i>paraensis</i> Huber	Myristicaceae	0.63	999	28	244	4
Red Sucupira	<i>Andira parviflora</i> Ducke	Leguminosae	0.77	556	13	1,101	18
Red Tauari	<i>Cariniana</i> <i>micrantha</i> Ducke	Lecythidaceae	0.58	466	19	235	7
Tauari- cachimbo	<i>Cariniana rubra</i> Ducke	Lecythidaceae	0.65	263	6	452	17

Tanibuca	<i>Buchenavia viridiflora</i>	Combretaceae	0.72	95	20	62	3
Louro-aritú	<i>Licaria aritu</i>	Lauraceae	1.04	282	21	31	1
Timborana	<i>Piptadenia suaveolens</i> Miq.	Leguminosae	0.74	27	0	595	21
Pequiá-marfim	<i>Aspidosperma desmanthum</i> Benth exMuell. Arg.	Apocynaceae	0.69	359	13	210	8
Cedrinho	<i>Scleronema micranthum</i> (Ducke) Ducke	Bombacaceae	0.59	1,071	4	3,350	16
Bitter bean	<i>Vatairea paraensis</i> Ducke	Leguminosae	0.78	279	4	590	16
Guariúba	<i>Clarisia racemosa</i> Ruiz & Pav.	Moraceae	0.59	603	2	991	17
Muiracatiara	<i>Astronium lecointei</i> Ducke	Anacardiaceae	0.79	70	5	200	14
Angelim-stone	<i>Hymenolobium modestum</i> Ducke	Leguminosae	0.65	871	9	1087	9
White Pitch	<i>Protium paniculatum</i> March	Burseraceae	0.84	476	5	603	13
Muirapiranga	<i>Brosimum rubescens</i> Taub	Moraceae	0.95	179	14	80	4
White Tauari	<i>Couratari guianensis</i> Aubl.	Lecythidaceae	0.52	7	0	707	14
Manioc	<i>Qualea paraensis</i> Ducke	Vochysiaceae	0.66	754	9	141	2
Jutaí pororoca	<i>Dialium guianense</i> (Aubl.) Sandw.	Leguminosae	0.85	13	0	194	9

Angelim-do-campo	<i>Andira laurifolia</i> Ducke	Leguminosae	0.67	3	0	2052	8
Maparajuba	<i>Manilkara cavalcantei</i>	Sapotaceae	0.83	59	4	8	3
Ipê	<i>Tabebuia serratifolia</i> (G. Don) Nichols.	Bignoniaceae	0.87	3	1	23	5
Taxi-amarelo	<i>Sclerolobium chrysophyllum</i> Poepp. & Endl.	Leguminosae	0.52	0	0	95	3
Jacareúba	<i>Calophyllum brasiliense</i> Comb.	Clusiaceae	0.56	71	3	0	0
Jarana	<i>Lecythis poiteaui</i> O. Berg.	Lecythidaceae	0.8	114	2	0	0
Angelim-fava	<i>Hymenolobium excelsum</i> Ducke	Leguminosae	0.63	0	0	6	2
Acariquara	<i>Minuartia guianensis</i> Aubl.	Olcaceae	0.85	144	0	520	1
Marupá	<i>Simarouba amara</i> Aubl.	Simaroubaceae	0.39	0	0	89	1
Pequiarana	<i>Caryocar glabrum</i> (Aubl.) Pirs	Caryocaraceae	0.61	3	0	3	1
Black Sucupira	<i>Diploptropis racemosa</i> Amsh	Leguminosae	0.78	11	0	82	0
Violet	<i>Peltogyne catingae</i> Ducke	Leguminosae	0.81	24	0	26	0
Yellow Laurel	<i>Licaria rígida</i> Benth	Lauraceae	0.73	1	0	2	0
Beech laurel	<i>Roupala Montana</i> Aubl.	Proteaceae	0.77	1	0	0	0
Abiurana-guajará	<i>Pouteria cuspidata</i>	Sapotaceae	0.92	0	0	1	0

Melancieira	<i>Alexa grandiflora</i> Ducke	Leguminosae	0.53	0	0	1	0
<b>Total</b>				<b>20,89</b> <b>7</b>	<b>1,543</b>	<b>26,12</b> <b>2</b>	<b>1,277</b>

The leguminosae botanical family was the most representative among the forest species that had hollow spaces for both areas, followed by the families Lecythidaceae and Lauraceae, each containing five species. Observing that the species with the largest number of individuals explored in the two UPAS, were: *Ocotea neesiana*, *Manilkara huberi*, *Scleronema micranthum*. However, the species that obtained the greatest number of hollow individuals were: *Manilkara huberi*, *Ocotea neesiana*, *Mezilaurus itauba*, *Ocotea rubra*, *Caryocar villosum*, *Dinizia excelsa* and *Dipteryx odorata*.

As noted, the species *Ocotea neesiana* and *Manilkara huberi* appear as the species that have both the largest number of explored individuals, as well as the largest number of hollow individuals, for the two study areas. However, when viewed spatially, according to Figure 2, it is noticed that the distribution of these occurs in a different way. *Ocotea neesiana* is found to have dispersed occurrence over the entire management area, while the species *Manilkara huberi* has the occurrence in a more grouped form. Both species are common throughout the Brazilian Amazon, occurring on dry land, with high added commercial value.

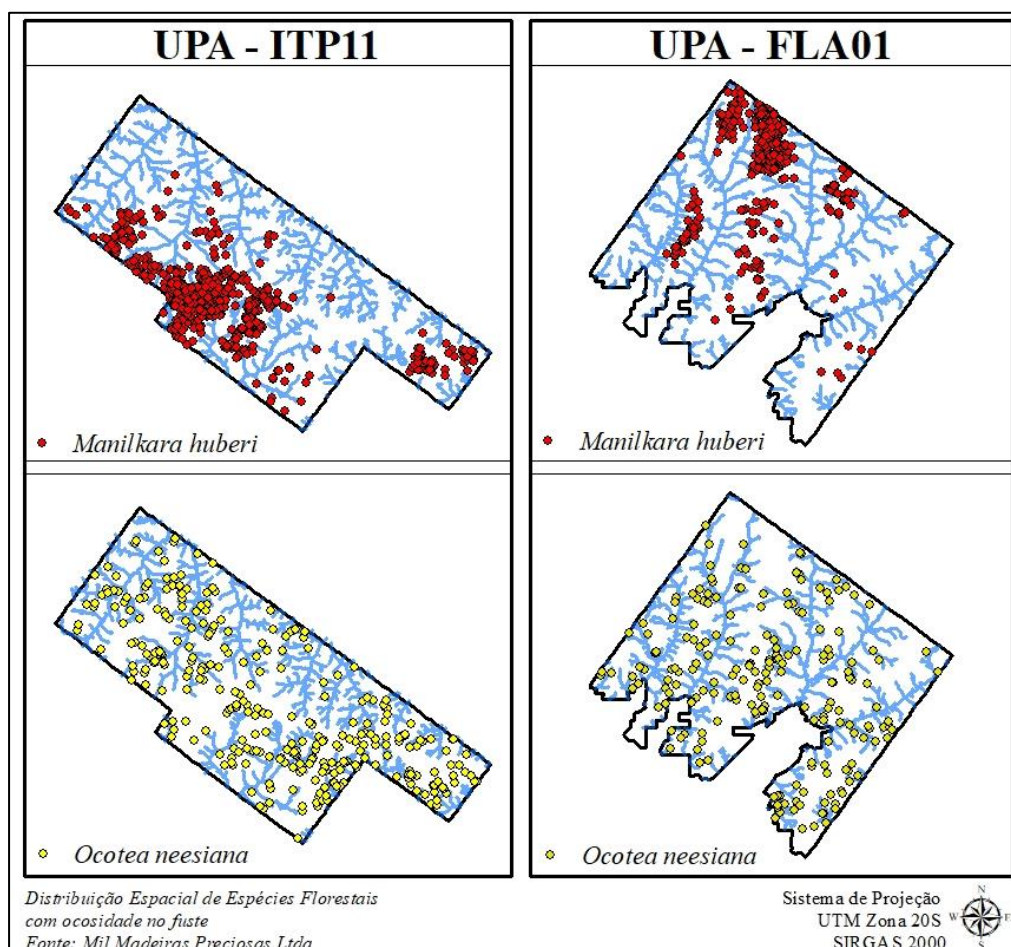




Figure 2. Spatialization of the species *Ocotea neesiana* and *Manilkara huberi*, identified with a greater number of arboreal individuals with hollowness for the two study areas.

Of all forest species explored in the two areas of the production unit, there were six that did not show hollow individuals, namely: *Licaria rigida*, *Roupala montana*, *Pouteria cuspidata*, *Alexa grandiflora*, *Peltogyne catingae* and *Diploptropis racemosa*, with emphasis on the two last species, popularly known as Violeta and Sucupira-Preta, respectively. Both species showed a significant number of individuals explored in both areas. For the species *Peltogyne catingae*, 24 and 26 tree individuals were found in the areas of the ITP11 and FLA01 production units, respectively, while for the species *Diploptropis racemosa*, 11 tree individuals were explored in the UPA ITP11 and 82 in the UPA FLA01.

The basic density of wood was one of the parameters observed in this research, since, according to research carried out by INPA / CPPF (1991) and by Corassa (2014), low density wood is more easily deteriorated by xylophagous organisms, as they have certain mechanical ease of entering them.

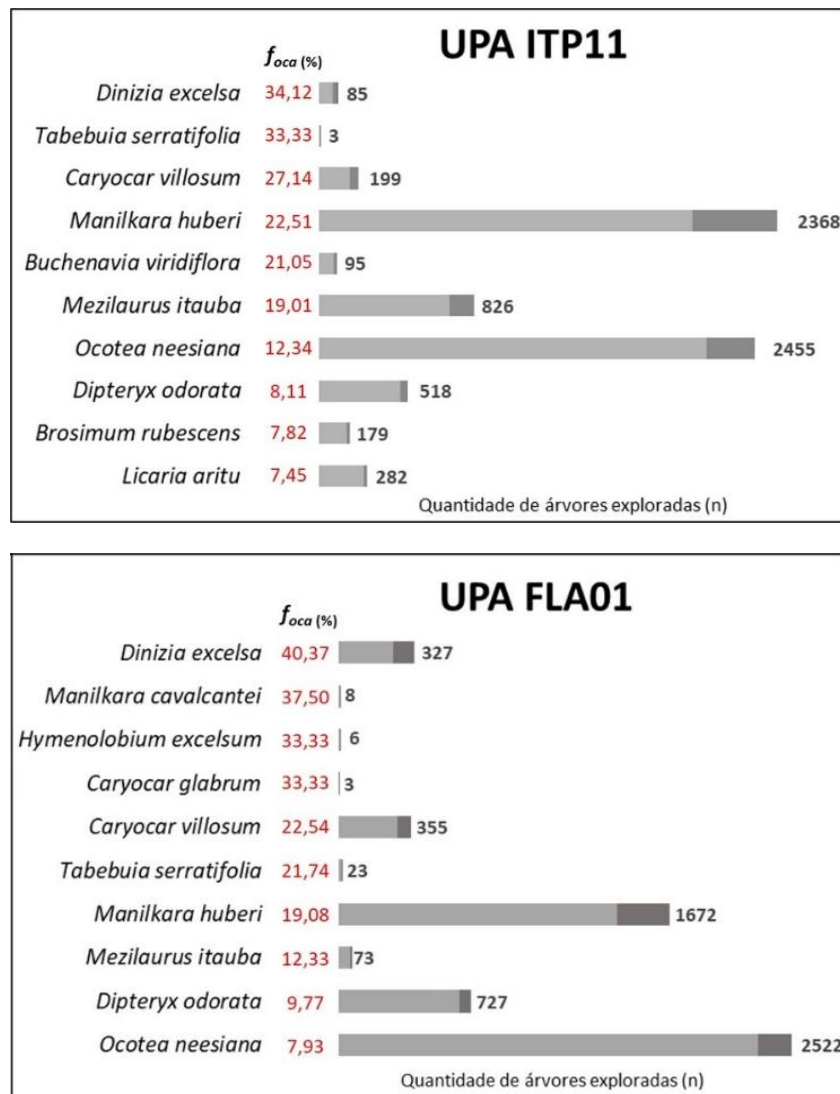
Therefore, of the 49 species explored for the two study areas, about 55% are classified as high density wood, and the other 45%, correspond to medium density wood. These species, in general, should provide greater mechanical resistance to avoid wood degradation by xylophagous organisms. However, a significant number of hollow individuals was observed, showing that species of high and medium basic density are also susceptible to attack by xylophages.

Corroborating with these results, the Eleutério (2011) research carried out in the eastern Brazilian Amazon with the objective of identifying the distribution of hollow trees in a wood management area, also obtained similar results, since most hollow trees belonged to species with high wood density (such as *Dinizia excelsa* Ducke, *Manilkara huberi*, *Manilkara bidentata*, *Astronium lecointei*, among other species).

In addition, Eleutério (2011) also observed that, one of the inherent factors for the identification of hollow trees in the field, was the diameter of the stem, because the larger the diameter and the older aspect of the trees, the greater the probability of the occurrence of hollowness in the arboreal individual. Different results were found by Medeiros et al (2017) and Barros et al (2019), when researching the quality of the wood of 19 Amazonian trees with small diameters, detected the presence of hollowness along the stem in most trees at the time mechanical processing, verifying that some trees presented these characteristics from the middle to the apex of the commercial shaft.

However, the relationship between the density of the wood and the occurrence of hollowness may be conditioned by the mechanical support of the wood, where trees with a higher basic density can provide greater resistance to biotic and abiotic forces that cause the stem to break, thus being able to guarantee their survival for long periods.

For the general diagnosis of the occurrence of hollow trees, the 10 most frequent species of hollow individuals are shown for the two areas of forest management, UPA ITP11 and FLA01, according to Figure 3.



**Figure3.** Diagnosis of the frequency of occurrence of hollow trees in the two study areas.

It is noted that the species that obtained the greatest number of explored individuals, concomitantly with the largest number of hollow individuals, seen previously, did not necessarily present higher frequencies of occurrence of hollowness. The species *Dinizia excelsa* Ducke, popularly known as angelim vermelho, presented a great occurrence of hollowness for the two areas under study. In the work of Eleutério (2011), this same species with an intermediate abundance in a universe of 38 species studied, was the most hollow, with a frequency of hollowness greater than 20%.

According to engineers responsible for the company<sup>1</sup>, who monitor the entire process of forest management activities, they reported that *Dinizia excelsa*, *Manilkara huberi* and *Mezilaurus itauba* species are the most frequently observed for these and other areas of forest management activities, practiced over the years by the timber company.

Thus, the diagnosis showed the significant presence of hollow trees in forest management areas in the Amazon region, which compromises the wood yield for the activity. Some logging companies avoid cutting down hollow trees as they cause a significant decrease in the volume of wood, which is also calculated when planning forest management activities. As a way of minimizing volume losses due to the

<sup>1</sup> Conversa informal: Engenheiros Florestais Bruno e Marcos

occurrence of hollow individuals, Emmert (2014) proposes that these hollow trees could be identified and marked in the forest inventory, avoiding the loss of time and excluding them from the volumetric wood planning and the list of possible cut trees.

However, the identification of these hollow trees in the field is a very complex issue, since the occurrence of the hollow in the shaft can vary from the base to the top, as well as in the degree of deterioration. Thus, it is noted the importance of timber companies to opt for the adoption of new technologies with the use of non-destructive techniques to assess the quality of the wood in the standing tree, before the process of selection of trees for exploration, as proposed by Medeiros (2013) and by Santos (2019), when they used impulse tomography, proving that it is possible to use this technique to classify hollow trees of some tree species.

## CONCLUSION

Arboreal species in the Amazon have a hollow presence, which occur mainly in high density basic species of wood. Despite the general diagnosis of the occurrence of hollow trees pointing out that these are not the majority in forest areas, it was observed that for every 23.5 thousand tree species inventoried in management areas, about 6.2% (approximately 1.5 thousand trees) have a hole in its stem. The result of the diagnosis reinforces the importance of citing hollow trees in legislation, both in terms of the appropriate methodologies for identifying these in the field, and also in terms of volumetric use in sawmills, in order to certify sustainability for the activity, regardless of the structural aspect of forest individuals.

## BIBLIOGRAPHY

Almeida, Vivian Barroso. Impacto da ocorrência de oco no rendimento volumétrico e financeiro da colheita de madeira na Floresta Nacional de Saracá-Taquera, Pará. 2018. 53 p. Dissertação (Mestrado em Ciências Florestais) - Universidade Federal Rural da Amazônia, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior.

Barros, Sámia Valéria dos Santos ; Higuchi, Niro ; Nascimento, Claudete Catanhede do ; Araújo, Roberto Daniel de ; Filho, Prof. Dr. Flávio de São Pedro . Wave Propagation Technology in Non-destructive assays for Wood Qualifying in Tropical Amazon. *International Journal for Innovation Education and Research*, v. 7, p. 259-274, 2019.

Barros, Ana Cristina; Verissimo, Adalberto. **A expansão madeireira na Amazônia: Impactos e perspectivas para o desenvolvimento sustentável no Pará**. 2º. ed. Belém, Pará: Imazon, 2002. 166 p.

Braz, Rafael Leite et al. Caracterização anatômica, física e química da madeira de clones de *Eucalyptus* cultivados em áreas sujeitas à ação de ventos. **Ciência da Madeira**, [S.l.], v. 5, n. 2, p. 127-137, set. 2014.

Braz, Rafael Leite et al. Resíduos da colheita florestal e do processamento da madeira na Amazônia – uma análise da cadeia produtiva. **Journal of Biotechnology and Biodiversity**, [S.l.], v. 5, n. 2, p. 168-181, maio. 2014.

Corassa, Janaína de Nadai et al. Témitas Associados à Degradação de Cinco Espécies Florestais em Campo de Apodrecimento. [S.l.]: **Floresta e Ambiente**, 2014. 7 p.

Danielli, Filipe Eduardo et al. Modelagem do rendimento no desdobro de toras de *Manilkara* spp.

(Sapotaceae) em serraria do estado de Roraima, Brasil. **ScientiaForestalis**, Piracicaba, v. 44, n. 111, p. 641-651, set. 2016.

Danielli, Filipe Eduardo. Modelagem do rendimento no desdobro de toras de *manilkara* spp. (Sapotaceae) em serraria na nova fronteira madeireira do estado de Roraima, Brasil. 2013. 82 p. Dissertação (Mestrado em Ciências de Florestas Tropicais) – Ciências de Florestas Tropicais, Instituto Nacional De Pesquisas Da Amazônia, Manaus, Amazonas, 2013.

Eleutério, Ana Alice. **Wood decay in living trees in eastern Amazonia, Brazil**. 2011. 102 p. Thesis (doctorate in philosophy) – Faculty of Environmental Sciences, University of Florida, Florida, 2011.

Emmert, F. 2014. Combinação de dados de campo e métodos computacionais para o planejamento da exploração florestal na Amazônia. Tese De Doutorado. Universidade de Brasília.

INPA/CPPF. 1991. Catálogo de madeiras da Amazônia: Características tecnológicas; Área da Hidrelétrica de Balbina. CPPF/INPA, Manaus, 163p.

Lima, José Ricardo Araújo; Santos, Joaquim dos; Higuchi, Niro. Situação das indústrias madeireiras do estado do Amazonas em 2000. **Acta Amazônica**. V. 35, n. 2, p. 125-132, 2005.

Medeiros et al. **Tomografia de impulso na avaliação da sanidade e rendimento *Micrandopsis scleroxylon* W. Rodr.** 2017. Nativa, Sinop, v.5, esp., p. 649-655, dez. 2017.

Medeiros, Romulo Geisel Santos. Avaliação do rendimento da madeira de árvores de floresta em pe por meio de metodologia nao destrutivas. 2013. Dissertação (Mestrado em Ciências Florestais e Ambientais) - Universidade Federal do Amazonas, Coordenação de Aperfeiçoamento de Pessoal de Nível Superior.

Medeiros, R. ; Nascimento, C. C. ; Barros, S. V. ; Paula, E. V.m. ; Higuchi, N. . Tomografia de impulso na avaliação da sanidade e rendimento de *Micrandopsis scleroxylon* W. Rodr. NATIVA, v. 5, p. 649, 2017.

Minetti, L. J.; Filho, R. F. de O.; Pinto, L. A. de A.; Souza, A. P. de; Fiedler, N. C. Análise técnica e econômica o corte florestal planejado de floresta tropical úmida de terra firme, na Amazônia Ocidental. Revista Árvore, v. 24, n. 4, p. 429-435, 2000.

Pereira, Denys et al. **Fatos Florestais da Amazônia**. Belém, Pará: Imazon, 2010. 126 p.

Pereira, Denys; Lentini, Marco. **Guia SAMFLOR: Sistema de Apoio ao Manejo Florestal**. Belém, Pará: Imazon, 2010. 68 p.

Santos, Filipe Bruno Batista dos. Potencial Tecnológico de espécies Arbóreas por tomografia de impulso para auxiliar no manejo Florestal na Amazonia. 2019. Dissertação (Mestrado em Ciências florestais e ambientais -PPGCIFA) - Universidade Federal do Amazonas, Conselho Nacional de Desenvolvimento Científico e Tecnológico.

# **Production strategy influence on the economic viability of a family fish farm in Pará state, Amazon, Brazil**

**Marcos Ferreira Brabo**

Professor, Institute of Coastal Studies, Federal University of Pará,  
Bragança, Pará, Brasil.

ORCID: <https://orcid.org/0000-0001-8179-9886>

Email: marcos.brabo@hotmail.com

**Gerfeson Almeida da Silva**

Fisheries Business Consultant,  
Bragança, Pará, Brasil.

Email: gerfesonasilva@gmail.com

**Daniel Abreu Vasconcelos Campelo**

Professor, Institute of Coastal Studies, Federal University of Pará,  
Bragança, Pará, Brasil.

ORCID: <https://orcid.org/0000-0001-9204-3566>

Email: danielvc@ufpa.br

**Galileu Crovatto Veras**

Professor, Institute of Coastal Studies, Federal University of Pará,  
Bragança, Pará, Brasil.

ORCID: <https://orcid.org/0000-0002-9975-830X>

Email: galiveras@hotmail.com

**Andréia Santana Bezerra**

Professor, Institute of Veterinary Medicine, Federal University of Pará,  
Castanhal, Pará, Brasil.

ORCID: <https://orcid.org/0000-0002-9611-3266>

Email: andreiazootecnistaufra@gmail.com

**Marcos Antônio Souza dos Santos (Corresponding author)**

Professor, Socioenvironmental and Water Resources Institute, Federal Rural University of the  
Amazon,  
Belém, Pará, Brasil.

ORCID: <https://orcid.org/0000-0003-1028-1515>

Email: marcos.marituba@gmail.com

## Abstract

The objective of this study was to analyze the influence of the adoption of single-phase and two-phase system on the economic feasibility of tambaqui (*Colossoma macropomum*) family production in the Tracuateua municipality, Pará state. The operational cost methodology and economic efficiency indicators were adopted to compare these rearing systems. The annual production was 4,200 kg and 5,826 kg. The operational costs were R\$ 26,169.00 and R\$ 34,365.00, the total operational cost was R\$ 27,505 and R\$ 35,701.00, and the total operational cost per kg was R\$ 6.55 and R\$ 6.13 for single-phase and two-phase systems, respectively. Regarding the indicators, the net present value was R\$ 24,180.70, the internal rate of return was 24%, the cost-benefit ratio was 1.19, and the capital return period was four years in the single-phase system. In the two-phase period, the net present value was R\$ 48,582.06, the internal rate of return was 29%, the cost-benefit ratio was 1.25, and the capital return period was 3.6 years. Despite the demand for greater investment, the two-phase system proved to be more profitable than the single-phase system, promoting even a reduction in unit production cost.

**Keywords:** aquaculture, *Colossoma macropomum*, production cost, two-phase system, single-phase system.

## 1. Introduction

In 2016, the fish production in Brazil from fish farming was 507.1 thousand tons. Tilapia *Oreochromis niloticus* (Linnaeus, 1758) accounted for 47.1% of the total, followed by tambaqui *Colossoma macropomum* (Cuvier, 1816), at 26.9%; and tambacu and tambatinga hybrids at 8.8%. Rondônia, Paraná, and São Paulo assume a prominent role, with 90.6, 76, and 48.3 thousand tons, respectively (IBGE, 2016).

In the northern region of Brazil, besides Rondônia, two other states could be integrating the first place in the national ranking, given their natural and socio-economic conditions: Amazonas and Pará. Amazonas occupies the eighth position, with 21 thousand tons, and Pará only the twelfth, with 12.9 thousand tons (IBGE, 2016). In this context, fish supply from extractive industries, logistical and infrastructural aspects, such as territorial extension, road trafficability, and access to electric energy, allied to issues that make up the production chain's institutional environment, such as environmental legislation and assistance, has hampered activity development (MPA, 2013).

In Pará state, fish farming is commercially practised predominantly on small farms, which use ponds as a rearing structure and adopt tambaqui as the main species, mostly under monoculture conditions (MPA, 2013). In general, activity is marked by low competitiveness, especially in isolated family initiatives regarding the social organization and poor technical assistance (Brabo et al., 2016 and Brabo, 2014).

The estimated productivity is 0.5 to 1.5 kg/ m<sup>2</sup>/year, depending on the production strategy adopted, such as monoculture or polyculture use; commercial, farm-made or alternative food use; emergency or routine aeration; partial replacement of water daily or only replacement of loss due to evaporation and infiltration; direct settlement or phased rearing; among other management forms (Gomes et al., 2010).

In the phased rearing, the single-phase system is characterized by the direct settlement of the young forms



in the fattening ponds, where the fish remain until they are removed. The two-phase system is characterized by the use of ponds' nurseries in the rearing and fattening ponds. Some enterprises may employ three-phase systems, where individual fish pass through two structures adopted as primary and secondary nurseries before reaching the fattening ponds. Therefore, the two- or three-phase systems used are detrimental to the single-phase system, making an enterprise more or less profitable and requiring an increase or decrease in business investment.

Considering that tambaqui is the most important species for fish farming in Pará state and the Brazilian Amazon, its production occurs mainly in ponds. The activity presents an expressive growth potential in the region. It is fundamental to understand the influence of the production strategy on the economic indicators of commercial enterprises to grow tambaqui in ponds, especially the total investment, production cost, and activity profitability.

This study aims to analyze the influence of adopting the single- and two-phase system on the economic viability of a family fish farm located in Tracuateua city, Pará state.

## **2. Materials and methods**

The study was conducted at Sítio Bom Gosto (46°56'20.71" S 00°58'26.31" W), a rural property located in the Flexal Community, Tracuateua municipality, Pará Northeastern mesoregion. In addition to fish farming in ponds, other agricultural activities were developed here, such as poultry, cattle rearing, and fruit-growing. The total property area was 35.6 hectares, the labor force used is predominantly the family itself, which was also responsible for the management of economic activities, and this enterprise is categorized as a rural family in accordance with Law No. 11,326 of July 24, 2006 (Brazil, 2006).

The infrastructure and required inputs surveying for tambaqui farming occurred from January to June 2017, through monthly excursions to the enterprise to follow the fish farming routine and interviews with the owner about the management adopted, such as pond preparation, settlement, fish feeding, biometrics, fish removal, and production scheduling. In the same period, a price survey was conducted in the local market. For items that were not available; the price in the supplier city plus shipping was considered, such as for bottom trawl and dynamometric weighing-machine.

The analyzed fish farm had a depth of 4,200 m<sup>2</sup> water, supplied by pumping. The farm was divided into four ponds with 1,404 m<sup>2</sup>, 1,287 m<sup>2</sup>, 805 m<sup>2</sup>, and 704 m<sup>2</sup> areas. The liming of the ponds occurred with quicklime in the proportion of 100 g/m<sup>2</sup> and fertilization with chicken manure tanned in the proportion of 50 g/m<sup>2</sup>. The fingerlings were purchased with an approximate weight of 5g from a producer with identified microchip broodstocks located in the Peixe boi municipality. The transport takes three hours by road. Feeding occurred exclusively with extruded commercial feed, feed rate, feed frequency, and grain size criteria. The biometrics were carried out monthly, and the production cycle lasted about a year to obtain a final weight of 1 kg. The commercialization took place mainly in the holy week.

Thus, two production strategies were economically analyzed: 1) the single-phase system, which was already carried out by the entrepreneur, where the direct young forms' settlement occurred in the fattening ponds at a stocking density of 1 individual/m<sup>2</sup> and 20% mortality rate estimate, number of individuals included at the moment of settlement beyond that calculated regarding the pond area; 2) the

two-phase system, where the 1,287 m<sup>2</sup> pond was defined as a nursery, with a production cycle of 120 days, a final weight of 400 g in the rearing, a stocking density of 2.5 individuals/m<sup>2</sup> and 20% mortality rate estimate; and 120 days to obtain a final weight of 1 kg in fattening at a stocking density of 1 individual/m<sup>2</sup>.

For production cost estimation, the operational cost structure proposed by Matsunaga et al. (1976) was executed using the following items: 1) effective operational cost (EOC) = sum of labor costs, social charges, inputs' acquisition, and equipment maintenance (3% of EOC), that is, actual expenditure (disbursement) by the investor; 2) Total Operational Cost (TOC) = sum of Effective Operational Cost (EOC) with capital goods' depreciation, which in this case was calculated using the straight-line method.

The economic efficiency indicators adopted in work were those defined by Martin et al. (1998): 1) Gross Revenue (GR) = annual production multiplied by the average wholesale sales price; 2) Annual Operational Profit (OP) = difference between Gross Revenue and Total Operational Cost; 3) Monthly Operational Profit (MOP) = Operational Profit divided by the number of months of the year; 4) Gross Margin (GM) = difference between Gross Revenue and Total Operational Cost, divided by Total Operational Cost, represented in percentage; 5) Profitability Index (PI) = Operational Profit divided by Gross Revenue, represented in percentage; and 6) Equilibrium Point (EP): Total Operational Cost divided by the average wholesale selling price.

For the investment analysis, cash flow was elaborated, and economic viability indicators were determined. Cash flow was calculated based on investment spreadsheets, operating expenses (outflows), and revenues (receipts) for a 25-year horizon. Net cash flow (NCF), resulting from the difference between cash inflows and outflows, was used to calculate the following indicators: 1) Net Present Value (NPV) = present value of the benefits less the current value of costs or disbursements; 2) internal rate of return (IRR) = interest rate that equals the total investments or costs to the returns or total benefits obtained during the project life; 3) cost-benefit ratio (CBR) = ratio between the current value of the expected returns and the estimated costs' value; and 4) the capital return period (CRP) = the time required for the sum of future net nominal revenue to equal the initial investment value. The discount rate or minimum attractiveness rate (MAR) adopted for NPV and CBR evaluation was 10%.

### **3. Results and discussion**

The project implementation cost was R\$ 21,420.00, with the pond excavation being the most relevant item of the initial investment with a 70% participation (Table 1). In this case, the backhoe used in the earthmoving could move 70 m<sup>3</sup> of material per hour, and the fuel value and the operator compensation embedded were in its price.

Table 1. Implantation Cost of a tambaqui's (*Colossoma macropomum*) family enterprise in ponds with 0.42 hectare of water depth in Pará state, 2017.

Item	Unity	Quantity	Unity value (R\$)	Total value (R\$)	%	Useful life (years)	Annual depreciation (R\$)
Area cleaning	Man/day	4	50.00	200.00	0.9	-	-
Topographic survey	Hectare	1	400.00	400.00	1.9	-	-
Pond's excavation	Hour/machine	60	250.00	15,000.00	70.0	25	600.00
Pipes and fittings	Note	-	-	500.00	2.3	5	100.00
Hydraulic pump	Unity	1	3,000.00	3,000.00	14.0	10	300.00
Bottom trawl	Unity	1	1,200.00	1,200.00	5.6	5	240.00
Hand nets	Unity	1	100.00	100.00	0.5	5	20.00
Weighing-machine	Unity	1	150.00	150.00	0.7	5	30.00
Hand Carriage	Unity	1	180.00	180.00	0.8	5	36.00
Plastic bucket	Unity	2	25.00	50.00	0.2	5	10.00
Other costs	Note	-	-	640.00	3.0	-	-
Total	-	-	-	21,420.00	100		1,336.00

Analyzing the implantation cost of zootechnical facilities for fish farming in Pará Northeast, Brabo et al. (2014) identified the difficulty of renting machines for short periods, such as crawler tractors and backhoe loaders for earthmoving service execution and hydraulic work construction. This is due to the cost of moving these machines as it demands auxiliary transport.

Vilela et al. (2013) found a value of R\$ 35,053.50 for constructing one water hectare divided into ten ponds for fish farming. Barros et al. (2016) stated that multitudes of structures per water hectare increases the number of used hours/machine, raising the implantation cost. In this study, four ponds formed 0.42 hectares of the flooded area and were built with R\$ 15,000.00. This amount can be considered similar to the cited research, even with the time difference between the two works.

Regarding the production cost of single-phase system adoption, the EOC corresponded to R\$ 26,169.00, the TOC was R\$ 27,505.00, and TOC per kilogram of produced tambaqui totaled R\$ 6.55. Regarding the items that were integrated the production cost, the feed was the most representative input, at 71.2% (Table 2).

Table 2. Production cost in the single-phase production of *Colossoma macropomum* in ponds from a family fish farm with 0.42 hectare of water depth in Pará state, 2017.

Item	Unity	Quantity	Unity value (R\$)	Total value (R\$)	%
Quicklime	Kg	420	2.00	840.00	3.1
Fertilizer	Kg	210	1.00	210.00	0.8
Quicklime and fertilizer shipping	Unity	1	70.00	70.00	0.3
Fingerlings	Thousand	6	250.00	1,500.00	5.5
Fingerlings' shipping	Unity	1	70.00	70.00	0.3
Feed 50%PB	Bag 25 kg	4	149.00	596.00	2.2
Feed 45%PB	Bag 25 kg	21	101.00	2,121.00	7.7
Feed 36%PB	Bag 25 kg	31	74.00	2,294.00	8.3
Feed 32%PB	Bag 25 kg	38	70.00	2,660.00	9.7
Feed 28%PB	Bag 25 kg	202	59.00	11,918.00	43.3
Feed freight	Unity	3	70.00	210.00	0.8
Eventual labor	Man/day	24	50.00	1,200.00	4.4
Fuel	Liter	60	4.00	240.00	0.9
Electricity	Note	-	600.00	600.00	2.2
Maintenance	Note	-	-	820.00	3.0
Other costs	Note	-	-	820.00	3.0
Effective Operational Cost (R\$)	-	-	-	26,169.00	95.1
Annual Depreciation (R\$)	-	-	-	1,336.00	4.9
Total Operational Cost (R\$)	-	-	-	27,505.00	100
Annual production (kg)	-	-	-	4,200	-
Total Operational Cost (R\$/Kg)	-	-	-	6.55	-
Wholesale Price (R\$/Kg)	-	-	-	7.50	-

According to Brabo (2014), the high price of fish feed in the Pará state is because the region does not have a well-established Local Productive Arrangement (LPAs). The installed feed mills maintain prices equivalent to the traditional brands that are expensive because of the high shipping values as they are produced in other states. Studies such as Sabbag et al. (2011) in São Paulo State and Silva et al. (2012) in Paraná showed much lower prices of this input, due to the grain production availability and logistics in Brazil's Midwest, Southeast, and South regions, such as maize *Zeamays*, soy *Glycinemax*, and wheat *Triticum aestivum*.

In this study, the apparent feed conversion was estimated to be 1.8:1 at the end of the production cycle. Notably, a better feed conversion reduces the offered feed amount, which will consequently reflect the

investor's profit. For Dieterich et al. (2013), adequate food management in terms of feed rate and feed frequency allows food waste reduction, reducing this feed's costs.

Regarding the cash flow in single-phase system adoption, positive net flow attested the business economic viability. Revenue was higher than the cost of production. Therefore, the balance was positive between the fourth and fifth year, permissible in a fish farming project in ponds (Sanches et al., 2014; 2013).

The two-phase system, the EOC, TOC, and TOC per kilogram were R\$ 34,365.00, R\$ 35,701.00, and R\$ 6.13, respectively. Additionally, the ratio with 75.6% was the most relevant item (Table 3). The production cost values are superior to the single-phase system, but the unit cost was lower, demonstrating a productive process optimization.

Regarding the feed, this result is similar to the values found by Brabo et al. (2013). This author observed an input ranging from 66.27% to 73% in production costs when analyzing the economic viability of fish farming in the Tucuruí Reservoir. This value is close to the results found by Belchior and Dalchiavon (2017). They analyzed the tambaqui production viability in the municipality of Ariquemes/RO, where the feed cost accounted for 73.7% of the operating cost.

Table 3. Production cost in the two-phase rearing of *Colossoma macropomum* in ponds from a family fish farm with 0.42 hectare of water depth in Pará state, 2017.

Item	Unity	Quantity	Unity value (R\$)	Total value (R\$)	%
Quicklime	Kg	420	2.00	840.00	2.4
Fertilizer	Kg	210	1.00	210.00	0.6
Quicklime and fertilizer shipping	Unity	1	70.00	70.00	0.2
Fingerlings	Thousand	7	250.00	1,750.00	4.9
Fingerlings' shipping	Unity	2	70.00	140.00	0.4
Feed 50%PB	Saco 25 kg	5	149.00	745.00	2.1
Feed 45%PB	Saco 25 kg	28	101.00	2,828.00	7.9
Feed 36%PB	Saco 25 kg	43	74.00	3,182.00	8.9
Feed 32%PB	Saco 25 kg	53	70.00	3,710.00	10.4
Feed 28%PB	Saco 25 kg	280	59.00	16,520.00	46.3
Feed freight	Unity	3	70.00	210.00	0.6
Eventual labor	Man/day	24	50.00	1,200.00	3.4
Fuel	Liter	60	4.00	240.00	0.7
Electricity	Note	-	600.00	600.00	1.7
Maintenance	Note	-	-	1,060.00	3.0
Other costs	Note	-	-	1,060.00	3.0
Effective Operational Cost (R\$)	-	-	-	34,365.00	96.3

Annual Depreciation (R\$)	-	-	-	1,336.00	3.7
Total Operational Cost (R\$)	-	-	-	35,701.00	100
Total Operational Cost (R\$/Kg)	-	-	-	6.13	-
Wholesale Price (R\$/Kg)	-	-	-	7.50	-

The cash flow from the tambaqui reared in the two-phase system showed that the net flow is negative in the first year due to a single fish removal of individuals stocked in the ponds used in final fattening or finishing. However, the investor balance became positive between the third and fourth year, less than the single-phase system.

Table 4 compares the economic efficiency indicators obtained in the single-phase and two-phase systems, demonstrating the greater profitability of adopting the rearing and fattening phases is detrimental to the direct population.

Table 4. Comparison of production cost and economic efficiency indicators from two production strategies of tambaqui *Colossoma macropomum* ponds in a family fish farm in the Pará state, 2017.

Economic indicators	Production strategies	
	Single-phase	Two-phase
Total Investment (R\$)	47,589.00	55,785.00
Total Operational Cost (R\$)	27,505.00	35,701.00
Total Operational Cost per kg (R\$)	6.55	6.13
Gross Revenue (R\$)	31,500.00	43,695.00
Annual Operational Income (R\$)	3,995.00	7,994.00
Monthly Operational Income (R\$)	332.92	666.17
Gross Margin (%)	14.5	22.4
Profitability Index (%)	12.7	18.3
Equilibrium Point (kg)	3,667.3	4,760.1
Net Present Value (R\$)	24,180.70	48,582.06
Internal Rate of Return (%)	24	29
Relation Benefit Cost (R\$)	1.19	1.25
Period of Return of Capital (years)	4	3.8

The IRR values found in the two analyzed systems were higher than the minimum attractiveness rate (MAR), estimated at 10%. For Hoji (2010), the investment becomes economically viable when the IRR is higher than the MAR. As a parameter, Brabo et al. (2015) analyzed the economic viability of fingerlings production of rheophilic species in Pará Northeast and found a value of 38% for the IRR.

Finally, this study allows the technicians, fish farmers, and development agencies' reflect on the production strategies adopted in fish farms, as they directly influence their profitability. Thus, fish farms in the planning stage or already in operation should focus on other possibilities of increased productivity and survival, such as compensatory growth of species, construction designed to present staggered



production, and aspects related to the young forms and feed quality.

In conclusion, adopting a two-phase system requires a higher investment than the single-phase system for tambaqui rearing in the same infrastructure, mainly because of the difference in the feed amount to be used. However, this system's profitability is also higher, demonstrating the optimization of the structure available in this production strategy.

#### **4. Acknowledgement**

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) – Brasil (Finance Code 001).

#### **5. References**

- A.F. Barros, M.M. Maeda, A. Maeda, A.C.C. Silva, and A.J. Angeli, "Custo de implantação e planejamento de uma piscicultura de grande porte no Estado de Mato Grosso, Brasil", *Archivos de Zootecnia*, 2016, pp. 21-28. DOI: <https://doi.org/10.21071/az.v65i249.437>
- Brasil, 2006 Lei nº 11.326, de 24 de julho de 2006. Que estabelece as diretrizes para a formulação da Política Nacional da Agricultura Familiar e Empreendimentos Familiares Rurais. *Diário Oficial da União*, Brasília, 25 de julho de 2006, nº 118, Seção 1, pp. 1.
- E.B. Belchior, and F.C. Dalchiavon, "Economic viability of tambaqui production in the Municipality of Ariquemes-RO". *Boletim do Instituto de Pesca*, 2017, pp. 373-384. DOI: 10.20950/1678-2305.2017v43n3p373
- E.G. Sanches, F.C. Silva, and A.P.F.A. Ramo, "Viabilidade econômica do cultivo do robalo-flecha em empreendimentos de carcinicultura no Nordeste do Brasil". *Boletim do Instituto de Pesca*, 2014, pp. 577-588.
- E.G. Sanches, G.A.M. Tosta, and J.J. Souza-Filho, "Viabilidade econômica da produção de formas jovens de bijupirá (*Rachycentron canadum*)". *Boletim do Instituto de Pesca*, 2013. pp. 15-26.
- Gomes L.C., L.N. Simões, and C.A.R.M. Araújo-Lima, Tambaqui (*Colossoma macropomum*). In: BALDISSEROTTO, B. GOMES, L.C. *Espécies nativas para piscicultura no Brasil*. Editora UFSM, Santa Maria. 2010, pp. 175-204.
- Hoji M., *Administração financeira e orçamentária: matemática financeira aplicada, estratégias financeiras, orçamento empresarial*, 8<sup>th</sup> ed.. Atlas, São Paulo, 2010. pp. 43.
- Instituto Brasileiro de Geografia e Estatística - IBGE. *Produção da pecuária municipal 2016*. Retrieved from <<http://www.ibge.com.br>> [Accessed Dec 2, 2017].
- J.R. Silva, D.R. Rabenschlag, A.A. Feiden, W.R.B. Boscolo, A.A. Signor, and G.W. Bueno, "Produção de pacu em tanques-rede no reservatório de Itaipu, Brasil: retorno econômico". *Archivos de Zootecnia*, 2012. pp. 245-254.
- M. Matsunaga, P.F. Bemelmans, P.E.N. Toledo, R.D. Dulley, H. Okawa, and I.A. Pedroso, "Metodologia de custo de produção utilizado pelo IEA". *Agricultura em São Paulo*, 1976, pp. 123-139.
- M.C. Vilela, K.D. Araújo, L.S.E. Machado, and M.R.R. Machado, "Análise da viabilidade econômico-financeira de projeto de piscicultura em tanques escavados". *Custos e @gronegócioonline*,

2013. pp. 154-173.

M.F. Brabo, "Piscicultura no Estado do Pará: situação atual e perspectivas". Acta pesca, 2014, pp. 1-7.  
DOI: <https://doi.org/10.2312/Actafish.2014.2.1.i-vii>

M.F. Brabo, B.C.B. Dias, L.D. Santos, L.A. Ferreira, G.C. Veras, and R.A. Chaves, "Competitividade da cadeia produtiva da piscicultura no Nordeste paraense na perspectiva dos extensionistas rurais". Informações Econômicas, 2014, pp. 1-13.

.F. Brabo, C.E. Flexa, G.C. Veras, R.S. Paiva, and R.Y. Fujimoto, "Viabilidade econômica da piscicultura em tanques-rede no reservatório da Usina Hidrelétrica de Tucuruí, Estado do Pará". Informações Econômicas, 2013, pp. 56-64.

.F. Brabo, L.F.S. Pereira, L.A. Ferreira, J.W.P. Costa, D.A.V. E Campelo, and G.C. Veras, "A cadeia produtiva da aquicultura no Nordeste paraense, Amazônia, Brasil". Informações Econômicas, 2016, pp. 16-26.

M.F. Brabo, M.H.D. Reis, G.C. Veras, J.M. Silva, A.S.L. Souza, and R.A.L. Souza, "Viabilidade econômica da produção de alevinos de espécies reofílicas em uma piscicultura na Amazônia Oriental". Boletim Instituto da Pesca, 2015, pp. 667-685.

Ministério da Pesca e Aquicultura - MPA. 2013. Censo aquícola nacional - 2008. MPA, Brasília. 2013. Pp. 336.

N.B. Martin, S. Serra, M.D.M. Oliveira, J.A. Angelo, and H. Okawa, "Sistema integrado de custos agropecuários – CUSTAGRI". Informações Econômicas, 1998, pp. 7-27.

O.J. Sabbag, L.S. Takahashu, A.N. Silveira, and A.S. Aranha, "Custos e viabilidade econômica da produção de lambari-do-rabo-amarelo em Monte Castelo/SP: um estudo de caso". Boletim do Instituto de Pesca, 2011. pp. 307- 315.

T.G. Dieterich, F.R. Potrich, E.K. Lorenz, A.A. Signor, A.E Feiden, and W.R. Boscolo, "Parâmetros zootécnicos de juvenis de pacu alimentados a diferentes frequências de arraçoamento em tanques-rede". Pesquisa Agropecuária Brasileira, 2013, pp. 1043-1048.  
<http://dx.doi.org/10.1590/S0100-204X2013000800033>

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

## **Profile of peach palm fruit consumers in the Metropolitan Region of Belém, Pará, Brazilian Amazon**

### **Marcos Antônio Souza dos Santos (Corresponding author)**

Professor, Socioenvironmental and Water Resources Institute, Federal Rural University of the Amazon,

Belém, Pará, Brasil.

ORCID: <https://orcid.org/0000-0003-1028-1515>

Email: [marcos.marituba@gmail.com](mailto:marcos.marituba@gmail.com)

### **Daniellen Costa Protázio**

Agronomist, Federal Rural University of the Amazon,

Belém, Pará, Brasil.

Email: [daniellenprotazio@gmail.com](mailto:daniellenprotazio@gmail.com)

### **Gabriela Pereira da Costa**

Agronomist, Federal Rural University of the Amazon,

Belém, Pará, Brasil.

Email: [gi\\_gabrielacosta@hotmail.com](mailto:gi_gabrielacosta@hotmail.com)

### **Fabrizio Khoury Rebello**

Professor, Socioenvironmental and Water Resources Institute, Federal Rural University of the Amazon,

Belém, Pará, Brasil.

ORCID: <https://orcid.org/0000-0003-2398-4906>

Email: [fabriciorebello@hotmail.com](mailto:fabriciorebello@hotmail.com)

### **Cyntia Meireles Martins**

Professor, Socioenvironmental and Water Resources Institute, Federal Rural University of the Amazon,

Belém, Pará, Brasil.

ORCID: <https://orcid.org/0000-0002-5695-8504>

Email: [cyntiamei@hotmail.com](mailto:cyntiamei@hotmail.com)

### **Andréia Santana Bezerra**

Professor, Institute of Veterinary Medicine, Federal University of Pará, Castanhal, Pará, Brasil.

ORCID: <https://orcid.org/0000-0002-9611-3266>

Email: [andreiazootecnistaufra@gmail.com](mailto:andreiazootecnistaufra@gmail.com)

**Amanda da Silva Nogueira**

Agronomist, Federal Rural University of the Amazon,  
Belém, Pará, Brasil.

ORCID: <https://orcid.org/0000-0002-1369-9549>

Email: [nogueirasilvaamanda@gmail.com](mailto:nogueirasilvaamanda@gmail.com)

## Abstract

*People in the Amazon highly value the fruit of the peach palm (*Bactris gasipaes* Kunth), but its commercialization is hampered because of consumers' difficulty in identifying fruit of good quality. This study seeks to evaluate the behavior of peach palm fruit consumers in municipalities in the Belém Region in Pará State by conducting a survey of 200 consumers. Peach palm consumption frequency is low, and it has not grown over the past five years in the largest proportion of consumers. The attributes most consumers looked for when purchasing peach palm were its external aspects, displaying a preference for red, oily pulp, medium-sized fruits that were pitted. Consumers enjoy purchasing peach palm as bunches of raw fruit, and while they believe that the price is too high, they are willing to pay more for fruit of proven quality.*

**Keywords:** agricultural market, *Bactris gasipaes* Kunth, consumer behavior, fruit growing

## 1. Introduction

Peach palm (*Bactris gasipaes* Kunth) is a species native to tropical regions in the Americas. The first people of the Southwestern Amazon domesticated it from, having numerous primitive breeds (Clement et al., 2004). It presents a wide genetic diversity in its wild and domesticated populations, due to having gone through different stages of domestication and cultivation places, aiming to meet the preferences of human consumption in terms of color, flavor, and processing (Clement and Santos, 2002; Santos et al., 2011).

People in the Brazilian Amazon grown peach palms for fruit consumption. In the state of Pará, family farmers are the primary cultivators. Passed on from generation to generation, there are often clumps of peach palms scattered in backyards that serve as healthy and low-cost food for those who own the trees, which also provide income through the sale of their fruit.

People primarily consume peach palms after cooking and peeling them; it is often eaten with coffee, manioc flour, or salt. The fruit is an important food source for the population of Pará, as well as part of its cuisine and regional culture. Another common use is as animal feed.

Street markets, supermarkets, and street vendors sell fresh peach palms by the bunch or kilogram. At harvest time, street vendors sell the cooked fruit in neighborhoods and open markets, packaged in small polyethylene bags or plastic cups that contain 8 to 10 palms.

Peach palm has important nutraceutical properties, providing lipids, proteins, carbohydrates, starch, and fiber. It also contains carotene, a vitamin that contributes to the health of the eyes, hair, nails, and skin. Among the mineral salts present in the fruit are selenium, potassium, calcium, iron, and phosphorus (Cymerys and Clement, 2005). The total carotenoid gives the pulp an intense yellow color, significant

functional appeal, and a high caloric value (Yuyama and Cozzolino, 1996; Carvalho et al., 2009).

Currently, fruit with high levels of carotenoids attracts consumer attention because of its antioxidants, which fight free radicals present in the body that are responsible for the evolution of certain serious pathologies (Carvalho et al., 2013).

Peach palm fruits are among the vegetables with the highest selenium content (35 to 55 mcg/100 g), a mineral that aids in preventing cancer. A government program for sustainable development in the State of Amapá that added peach palm fruits to school menus, including them in porridges or mixed with savory dishes, has been well-received (Ministry of Health of Brazil, 2002).

In Costa Rica, researchers have proposed utilizing peach palm fruit as a substitute for corn due to its high nutritional value, particularly in retinol, since that is the nutrient most often lacking in the diet of children (Salas and Blanco, 1990).

Despite the countless studies that disclosed the important nutritional properties of peach palm fruits, consumption has not expanded in the Amazon region or Brazil (Clement et al., 2004). One hypothesis is that there are no varieties of peach palm on the market with well-defined fruit characteristics. This factor restricts the options for consumption, because without clearly defined characteristics to assist consumers in selecting the fruit, the peach palms they choose are often not palatable. For this reason, it is important to cultivate peach palm varieties whose fruits have characteristics that meet consumer desires (Van Leeuwen, 2006).

This study therefore seeks to identify the consumer profile for peach palm fruits in the Metropolitan Region of Belém in the State of Pará. It does this by identifying the consumers' socioeconomic profiles and their preferences regarding the characteristics of the fruit. It also assesses the behavior of fruit prices at free fairs.

## **2. Materials and method**

We conducted this study at nine free fairs in the municipalities of Belém and Ananindeua in the Metropolitan Region of Belém. Various neighborhoods held the free fairs: the Icoaraci District and Batista Campos, Campina, Guamá, Marco, Barreiro, Jurunas, Cidade Nova 4, and Cidade Nova 6. The selection of these locations took into account the potential for great markets, in addition to the variability of consumer preferences regarding issues related to fruit quality, income, place of purchase, fruit price, and consumption. The total population of the municipalities of Belém and Ananindeua in 2015 was approximately 1.9 million (IBGE, 2019). The survey methodology consisted of questionnaires given to 200 respondents who bought peach palm fruits. The sample was representative, and had a margin of error of 6.93% at a 95% confidence level. The data was collected between March and June 2015, the peak period for the peach palm fruit harvest, on Saturdays and Sundays. This was because peach palm fruits usually arrived at the point of sale on Fridays, and trade was more intense on weekends.

The questionnaire's first section collected the consumer's socioeconomic information, including age, sex, place of birth, marital status, occupation, education, and average family income. The second section covered issues related to how frequently the consumers purchased fruit, the factors they utilized to make their purchase decisions, their preferences, the fruit characteristics they desired, and their issues with the price of the fruit.

The collected data were organized in a database, and a spreadsheet was utilized to prepare the tables that served as a basis for analysis and interpretation. LibreOffice version 6.3.5 was employed to analyze the data statistically.

### 3. Results and discussion

#### 3.1 Socioeconomic Profiles

The results indicated that 59% of the respondents were male and 41% were female, and that 91.5% were from the state of Pará (see Table 1). Their ages varied between 18 and 95, with an average age of 51 and a standard deviation of 16. The predominant level of education was high school graduation (37.5%), followed by undergraduate degree (23%) and elementary school (16%). With regard to occupation, 33.5% of the respondents referred to themselves as self-employed, 20.5% worked in the private sector, 13.5% were civil servants, and 22.5% were retired or pensioners.

As for average family income, 62.1% earned below four minimum wages, while 31% had an average family income over five minimum wages. The research revealed that peach palm fruit consumption occurred across all social classes.

Table 1. Socioeconomic Characteristics of the Sample of Peach Palm Fruit Consumers (N=200) in the Metropolitan Region of Belém in the State of Pará.

Characteristic	Category	% of total
Gender	Man	59.0
	Woman	41.0
Age (years)	≤30	12.5
	31 – 45	24.5
	46 – 55	22.0
	56 – 65	21.5
	≥ 66	19.5
Marital status	Single	30.5
	Married	55.5
	Divorced	6.0
	Widow/Widower	8.0
Education level	Illiterate	0.0
	Elementary school	16.0
	Middle school	7.5
	Incomplete high school	7.5
	High school graduation	37.5
	Incomplete undergraduate	5.0
	Undergraduate degree	23.0
	Graduate degree	3.5
	Public server	13.5



Occupation	Private sector	20.5
	Retired/pensioner	22.5
	Autonomous	33.5
	Other activity	10.0
Origin	Metropolitan Region of Belém*	72.5
	State Interior	19.0
	Other State	8.5
Average family income (MW**)	Less than 1	4.0
	From 1 less than 2	23.0
	From 2 less than 3	21.0
	From 3 less than 4	14.5
	From 4 less than 5	6.5
	≥ 5	31.0

**Source:** Survey data (2015)

Notes: (\*) Including the municipalities of Ananindeua, Belém, Benevides, Castanhal, Marituba, Santa Barbara do Pará, and Santa Isabel do Pará. (\*\*) MW = Brazil's Minimum Wage during the research period (R\$ 788.00 in 2015).

### 3.2. Preferences and Consumption

43.2% of respondents classified their consumption frequency of peach palm fruit at home as low, as they purchased the product only sporadically, even during the harvest period. 38.7% classified their consumption as average, purchasing the product only during the harvest period, and 18.1% of respondents said their consumption was high, since they bought the product whenever it was available at free fairs.

For 56% of the respondents, their peach palm fruit consumption over the last five years had remained constant, with no significant increase or decrease in their consumption of the fruit at home. 24.5% of respondents, however, had increased their consumption over the last five years. Thus, the percentage of respondents who did not decrease their consumption was 80.5%, demonstrating that the fruit has the potential to expand its consumption.

Culture is one of the primary determinants of consumer behavior, so we sought to obtain data on consumers' consumption habits with regard to peach palm fruits. In most cases, people consume the fruit cooked and as a side dish. Only 11.5% of respondents reported consuming the fruit without any accompaniment (see Table 2). Among the side dishes listed by the respondents, coffee stood out, as 71% of consumers said they consumed the fruit with coffee as an afternoon snack. Another 22% mentioned cassava flour, a widely-used delicacy in Amazonian cuisine that enriches the diet, since peach palm fruits have a beneficial amount of protein. Only 7% of respondents reported consuming the fruit with other foods such as guava, cupuaçu candy, curd, tapioca flour, salt, lemon, pepper sauce, cheese, or honey.

Table 2. Peach Palm Fruit Consumption Methods in the Metropolitan Region of Belém, in the State of Pará.

Method of peach palm fruit consumption	%
<i>Consumption habit</i>	
Without an accompaniment	11.5
With an accompaniment	88.5
<i>Method of peeling fruit</i>	
Remove the peel with a spoon	1.91
Remove the peel with a knife	34.93
Remove the peel with your teeth	44.98
Remove the peel with your hands	18.18
<i>Form of consumption</i>	
Cooked	88.5
Other forms	11.5

**Source:** Survey data (2015).

Consumers are strongly impacted by their personal attributes, which relate to their experiences as children and their psychological characteristics. In general, people's past and current experiences influence them (Cobra, 2009). This may help explain the fact that many consumers (44.98%) reported that they peeled the cooked fruit with their teeth, while 18.18% said they peeled it with their hands, a common habit among Pará families (see Table 2).

One of the primary pleasures of consuming peach palm fruit is in the way one peels the fruit. If the way sellers presented peach palm fruit for sale changed, such as by offering pre-cooked and peeled fruit, consumers would probably not be satisfied with the new sales option. Thus, we can infer that culture strongly influences the habits related to both the consumption and peeling of peach palm fruits by passing those habits from generation to generation.

Consumers most often consumed the fruit directly, as 88.5% of the respondents reported consuming it plain after cooking it in salt water. However, there are other methods of preparation, especially among consumers with higher incomes. Among respondents who ate more elaborate peach palm fruit dishes at home, 60% were in the high family income category. Respondents reported preparing dishes such as: cream of peach palm fruit with pink shrimp, peach palm fruit flour, peach palm fruit with beef or fish, peach palm fruit jam, cakes, pudding, or puree, peach palm fruit lasagna, and stroganoff and risotto with peach palm fruit,. According to Clement et al. (2004), the peach palm fruit is an arboreal potato, and competes in the market against other sources of starch. Therefore, it has been highly valued in regional cuisine by renowned chefs. The southern part of the State of Bahia in Northeast Brazil has no tradition of consuming peach palm fruit; however, as news disseminates of the fruit's nutritional value and consumption methods, the people there have expressed interest in knowing, experimenting, and creating new means of eating the fruit, such as in porridge, cookies, cakes, couscous, or vatapá. An important aspect of the fruit is that it is gluten-free, allowing its use as flour in the diets of people allergic to gluten (Silva et al., 2011).

For consumption as either human or animal food, people must deactivate the peroxidase enzyme in the

peach palm fruit by subjecting the fruit to a heat treatment (Silva et al., 2011). On average, the way to deactivate the enzyme is to heat it to the ideal temperature of 105 °C for 20 minutes (Gallardo and Sierra, 1993). In light of this, 17.5% of respondents answered that some family members experienced throat irritation when they consumed peach palm fruits, which may be attributable to the presence of this enzyme.

### 3.3. Consumer preferences for the fruit's physical attributes

According to 30% of respondents, the external aspect (its roughness, stains, rot, cracks, and thorns) of the peach palm fruit is the most important attribute when selecting fruit to take home. The next most popular aspects were: oiliness (chosen by 18.5% of respondents), texture (16%), color (14%), fruit size (8%), bunch size (5%), and seed size (5%).

Fruit rot is associated with the presence of the fungus *Colletotrichum gloeosporioides*, which changes the color and texture of the fruit's epidermis from green/yellow to lighter tones, and later wrinkles and blackens it (Mota and Gasparotto, 1998). Cracks in the fruit are an important indicator of the fungus; however, in most cases, consumers buy them anyway because cracks also indicate coveted characteristics such as oiliness and texture.

One undesirable external aspect is the presence of thorns, since consumers do not want to risk injuring their mouths while eating. The thorns result from inadequate harvests, when the fruits grow towards the plant stem and come into contact with its spines.

An external characteristic that consumers do appreciate is the presence of bird pecking marks on the fruit. According to some respondents, this characteristic is an indication of superior quality fruit.

Texture is also important when making a purchase decision. The report of one respondent demonstrated this well by highlighting important characteristics during the fruit's preparation: "there are certain types of peach palm fruit that do not salt." Most respondents expressed a dislike of peach palm fruits with fibrous pulp and high moisture content. According to some consumers, one method to test for good texture is to peel the fruit at the time of purchase. If one can manage to remove the entire peel, then the fruit has good texture.

Examining consumption preferences related to the fruit's characteristics, 35.5% of respondents were indifferent to the color of the fruit. Some consumers explained that fruits with identical colors could be good or bad, so they did not consider color when selecting fruit. Despite this, red-colored peach palm fruit was the most desirable, favored by 29% of respondents, followed by yellow-colored fruit (23.5%), as shown in Table 3. For consumers in the city of Manaus, in the State of Amazonas, surveys have indicated that more than 50% of respondents preferred red-colored peach palm fruits (Clement and Santos, 2002).

Table 3. Preferences of peach palm fruit Consumers in the Metropolitan Region of Belém.

Consumer preferences regarding the characteristics of peach palm fruit (%)				
<i>Color</i>				
Indifferent	Yellow	Red	Orange color	Green
35.5	23.5	29.0	7.5	4.5
<i>Pulp</i>				
Indifferent	Oily	Dry	-	-

8.0	78.5	13.5	-	-
<i>Size</i>				
Indifferent	Great	Medium	Little	-
26.0	20.0	46.5	7.5	-
<i>Seed</i>				
Indifferent	Great	Medium	Little	Pitted
24.5	2.0	19.0	20.0	34.5

**Source:** Survey data (2015)

The respondents' appreciation for oily pulp fruit is indisputable. When questioned about their fruit pulp preferences, 78.5% opted for oily pulp fruit. As to their preferred fruit size, 46.5% of respondents opted for medium-sized fruit.

When carrying out morphometric analysis, researchers have classified peach palm breeds based on the size of the fruit, and assumed that the size reflected the breed's degree of domestication. One breed has intermediate-sized fruits and bunches, and is among the best for consumption. It has a pleasant texture and reasonable levels of carotene and oil, which contribute to its pleasant flavor (Souza et al. 2001).

Some respondents reported that there were large-sized peach palm fruits available for sale in the off-season that originated from planned plantings. However, the large fruit tends to be dry and have high levels of starch, which means it tends to have less oil content (Clement et al. 1998); this may explain why some consumers report disliking these off-season peach palm fruits.

As for peach palm seed size, 34.5% of consumers preferred seedless peach palms, as they have higher yield. This is because the peach palm is predominantly cross-pollinated, causing parthenocarpy that usually occurs in the first fruiting. Genetic, nutritional, and climatic factors are among those associated with parthenocarpy, along with the low efficiency of pollinating insects; when these factors interact, parthenocarpy occurs more frequently (Silva, 2015).

We tabulated the data to correlate respondent ages with their preferences in relation to fruit color. We discovered that indifference to fruit color gradually increased with age (see Table 4). This fact may be related to consumers' experiences, as consumers learn over time that the color of the fruit does not correlate with its quality. Thus, learning may also influence consumer behavior.

Table 4. Percentage of Customers Indifferent to Peach Palm Fruit Color by Age.

Age range(years)	≤ 30	31 - 45	46 - 55	56 - 65	> 65
Percent indifferent (%)	2.8	16.9	22.5	25.4	32.4

### 3.4. Price behavior

When asked about their satisfaction with the way seller market the fruit in clusters, 70% of respondents said they were satisfied with this sales pattern, regardless of their places of birth, family sizes, or family incomes. This behavior is associated with local culture, since purchasing peach palm fruit in clusters is the traditional way of marketing the fruit throughout the Amazon region.

Currently, peach palm fruit is sold raw in bunches or by the kilogram, while cooked peach palm fruit is

sold individually or by the kilogram. The price varies according to the form and quantity of the fruit. 54% of respondents considered the price of peach palms to be high, 42.5% thought it was satisfactory, and only 3.5% thought it was low. However, 68.5% of respondents stated that they would be willing to pay more for fruit that had the quality they desired.

The data in Table 5 indicate that the average sales price for raw peach palm fruit in the Metropolitan Region of Belém was R\$7.29/kg, with a standard deviation of R\$ 2.52/kg. There was a clear variation in fruit prices between the different research sites, with the lowest price observed at a fair in the neighborhood of Barreiro, and the highest in the neighborhood of Cidade Nova in Ananindeua. This fact occurs because of the consumers of these places that are differentiated, primarily, in terms of income and demand regarding fruit quality.

Table 5. Average Price per Kilogram of Peach Palm Fruit in Natura at Fairs in the Metropolitan Region of Belém during the 2015 Fruit Harvest.

Free fair/Neighborhood	Average price (R\$/kg)	Standard deviation	Variance coefficient VC (%)
Barreiro	6.00	2.66	44.31
Jurunas	6.15	2.13	34.61
Icoaraci	6.43	1.95	30.31
Guamá	7.08	2.74	38.79
Ver-o-Peso	7.67	3.29	42.88
Feira da 25	8.05	2.83	35.21
Batista Campos	8.07	2.23	27.69
Cidade Nova	8.39	1.96	23.37
<b>Total</b>	<b>7.29</b>	<b>2.52</b>	<b>34.60</b>

**Source:** Survey data (2015)

We observed the commercialization of cooked peach palms only in the free fairs such as 25 fair, Batista Campos, and Cidade Nova. In those places, sellers usually sold the fruit cooked as well as raw, providing free cooked fruit samples to consumers. The average price of portions with 8 to 10 fruits ranged between R\$2.00 and R\$5.00, with an average of R\$2.57 and a standard deviation of R\$1.07.

#### 4. Conclusion

Cooked peach palm fruit is highly valued by both urban and rural residents of the Brazilian Amazon, and is one of their favorite options for consumption during its harvest period. Therefore, a wide field of research seeks a better quality fruit to offer to the final consumer, since there is currently great variability in the fruit available.

Standardization of peach palm fruits for domestic consumption may expand the fruit's commercialization by helping consumers recognize the fruit characteristics they desire. Currently, its broad diversity, and consumers' difficulty in identifying good quality peach palms by their external characteristics before

cooking, restricts consumption of the fruit.

There is also ample potential for utilizing the fruit in regional cuisine by elaborating new, sophisticated dishes that serve a public with growing income. This niche can contribute to the strengthening of the market for this traditional Amazonian product.

## **5. Acknowledgement**

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) – Brasil (Finance Code 001).

## **6. References**

- A.V. Carvalho, J.C. Beckman, R de A. Maciel, and J.T. Farias Neto. Características físicas e químicas de frutos de pupunheira no estado do Pará, *Revista Brasileira de Fruticultura*, 2013, pp.763-768.
- A.V. Carvalho, M.A.M. Vasconcelos, P.A. Silva, and J. L. R. Ascheri. Produção de snacks de terceira geração por extrusão de misturas de farinhas de pupunha e mandioca, *Brazilian Journal of Food Technology*, 2009, pp.277-284.
- C.R. Clement, J.P.L. Aguiar and D.B. Arkcoll. Composição química do mesocarpo e do óleo de três populações de pupunha (*Bactris gasipaes*) do Rio Solimões, Amazonas, Brasil. *Revista Brasileira de Fruticultura*, 1998, pp.115-118.
- C.R. Clement and L.A. Santos. Pupunha no mercado de Manaus: preferências de consumidores e suas implicações. *Revista Brasileira de Fruticultura*, 2002, pp.778-779.
- C.R. Clement, J.C. Weber, J. Van Leeuwen, C. Astorga Domian, D.M. Cole, L.A. Arévalo Lopez and H. Argüello. Why extensive research and development did not promote use of peach palm fruit in Latin America, *Agroforestry Systems*, 2004, pp. 195-206.
- M. Cobra. Administração de marketing no Brasil. 3<sup>rd</sup> Edition, Elsevier, Rio de Janeiro, 2009.
- M. Cymerys and C.R. Clement. Pupunha *Bactris gasipaes* Kunth. In: P. Shanley and G. Medina, (Eds.). *Frutíferas e Plantas Úteis na Vida Amazônica*, Acre, 2005, pp. 203-208.
- V.M. del S. Gallardo and C.E.M. Sierra. Condiciones de secado para la obtención de harina de chontaduro (*Bactris gasipaes*). In: congreso internacional sobre biología, agronomía e industrialización del pijuayo, Universidad de Costa Rica, San José, 1993, pp. 294-295.
- IBGE, Instituto Brasileiro de Geografia e Estatística. Banco de dados agregados. Retrieved from <http://www.sidra.ibge.gov.br>. Updated: Feb 17, 2019.
- Ministry of Health of Brazil. Alimentos regionais brasileiros. Brazil, Brasília, 2002.
- A. M. Mota and L. Gasparotto, L. Fungos associados a “Síndrome da queda de frutos” da pupunheira. *Rev. U. A. Série: Ciências Agrárias*, 1998, p. 69-79.
- G.G. Salas and Blanco A. Un alimento infantil com base en pejibaye: su desarrollo y evaluación. *Boletim Informativo, U.C.R.*, 1990, p.12-14.
- R.P. Santos, M. Cristo-Araújo, D. Picanço-Todrigues, S. Astolfi-Filho and C.R. Clement. Variabilidade genética e fluxo gênico em populações híbridas e silvestres de pupunha acessada com marcadores RAPD. *Revista Brasileira de Fruticultura*, 2011, p. 1200-1208.



M.G.C.P.C. Silva, T.F. Maier, W.S. Barreto and B.A. Melo Nelo. Avaliação da composição química da farinha de pupunha processada crua e pós cozimento. I Simpósio Brasileiro da Pupunheira, desenvolvimento com sustentabilidade. Ilhéus, Bahia. 2011. Retrieved from: <http://www.ceplac.gov.br/paginas/pupunheira/download/Apresentacoes/ap%2822%29.pdf>. Updated May 20, 2015.

M.G.C.P.C. Silva. Cultivo da pupunheira. 2015. Retrieved from: <http://www.ceplac.gov.br/radar/CULTIVO%20DA%20PUPUNHEIRA.pdf>. Updated: August 12, 2015.

N.R. Souza , D.P. Rodrigues, C.R. Clement, E.O. Nagao, and S. Astolfi-Filho. Discriminação de raças primitivas de pupunha (*Bactris gasipaes*) na Amazônia brasileira por meio de marcadores moleculares (RAPDS). Acta amazônica, 2001, pp. 539-545.

J. Van Leeuwen. O melhoramento participativo da pupunheira (*Bactris gasipaes*) para a produção de fruto, uma proposta preliminar. In: ProBio: Pupunha: raças primitivas e parentes silvestres. INPA, Manaus, 2006, pp.2. Retrieved from:<<http://www.inpa.gov.br/pupunha/probio/melhora-particip.pdf>>. Updated May 20, 2015

L.K.O. Yuyama and S.M.F. Cozzolino. Efeito da suplementação com pupunha como fonte de vitamina A em dieta: estudo em ratos. Revista de Saúde Pública, 1996, pp.61-66.

### **Copyright Disclaimer**

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).

## **Thematic Analysis of Oromo Proverbs Said About Women**

**Alemitu Oli**

Department of Afan Oromo and Literature, College of Social Sciences and Humanities,

Jimma University, Jimma Ethiopia

ORCID: [iDhttps://orcid.org/0000-0003-2307-9105](https://orcid.org/0000-0003-2307-9105)

[alemituoli@gmail.com](mailto:alemituoli@gmail.com)

### **Abstract**

*The purpose of this study is to look at the representation of women in the Oromo proverbs and to evaluate the awareness of the society about the effects of these proverbs on women. To achieve this goal, an attempt was made to collect proverbs that refer to women. The data was collected from pre documented books because of the inconvenience of data collection in the field due to the COVID-19 pandemic. The collected data was translated from the original language 'Afaan Oromoo' to the target language 'English' and finally analyzed and interpreted qualitatively. From the result, women are portrayed both positively and negatively in Oromo proverbs, and the image of a mother and wives are positive. They are represented as excellent house makers and obedient servants of their family. This study, also found out that women are perceived negatively and disrespected in Oromo proverbs. Male dominance and the inferior position and the low status of women are clearly observed. In these proverbs, women are perceived as ignorant, dependent, weak, irresponsible, unpredictable, and as inferior members of their community. In general, the actual characteristics of women are considered as nothing and ideal behaviors are disseminated in proverbs and in cultural trends. The transmission of these proverbs has a contribution to the perpetuation of the negative images of women and this causes women's negative self-image and their low participation in different social affairs in their community. Therefore, educating women, giving awareness creation training about women's equality to the society, increasing women's participation, and discouraging the use of the proverbs that socialize the inferior status of women may be a solution to create a better positive image of women in the society.*

Key words: Oromo, thematic, proverbs, women

### **1. Introduction**

Folklore is the traditional art, literature, knowledge, and practice that are disseminated largely through oral communication and behavioral example. Every group with a sense of its own identity shares, as a central part of that identity, folk traditions—the things that people traditionally believe (planting practices, family traditions, and other elements of worldview), do (dance, make music, sew clothing), know (how to build an irrigation dam, how to nurse an ailment, how to prepare barbecue), make (architecture, art, craft), and say (personal experience stories, riddles, song lyrics). As these examples indicate, in most instances, there is no hard-and-fast separation of these categories, whether in everyday life or in folklorists' work.

The word "folklore" names an enormous and deeply significant dimension of culture. Considering how large and complex this subject is, it is no wonder that folklorists define and describe folklore in so many different ways. Try asking dance historians for a definition of "dance," for instance, or anthropologists for a definition of "culture." No one definition will suffice—nor should it.

As to Barbro (2001) 'Folklore' has four basic meanings. First, it denotes oral narration, rituals, crafts, and other forms of vernacular expressive culture. Second, folklore, or 'folkloristic,' names an academic discipline devoted to the study of such phenomena. Third, in everyday usage, folklore sometimes describes colorful 'folkloric' phenomena linked to the music, tourist, and fashion industries. Fourth, like a myth, folklore can mean falsehood.

The focus of the study is the oral literary genre of folklore which is proverbs. Oral literature is a highly wide-scoped concept of any society's oral tradition. Bascom,(1968) stated that verbal arts serve to keep cultural continuity from one generation to another generation. Proverbs are one of the various genres of folklore. According to Finnegan, (1970), proverbs are very brief sayings with extremely compact messages shared by a large number of people, and they 'tersely' communicate social truths. It is also agreed upon by many scholars that proverbs, in previous times, and even today, especially, in the non-literate (traditional) society, play a great role in the people's culture of educating one another; appreciating, commenting on, and criticizing behaviors, religions, norms, values, leadership and in bringing up their offspring according to their norm. In other words, a proverb is a mirror in which its society observes its whole being.

According to D'Angelo, (<http://links.jstor.org>.) "Almost every nation has its share of proverbs and sayings." He asserted that "Because proverbs are so familiar, they often win uncritical acceptance from the audience..." Thus, like any other African society, the Oromo have their own oral tradition, of which proverbs are the popular ones that elders most often use as a spice of their speech in every context of life.

Formerly, the oral tradition of the Oromo people was not found in a written form because of the political influence of the country on Oromo literature. These days, however, few of them are collected and found in a written form only in very limited sites and they belong to only a limited area of the people in the region. Since proverbs are linked with every aspect of people's lives, it is difficult to study all types of proverbs in society at a time. As a result, for the time being, there are few works that analyze the positive as well as the negative effects of proverbs on women. Proverbs have unlimited importance in the Oromo, it is difficult to say they have no pitfalls. The Oromo have a special place for their mothers, wives, and sisters with which they express their respect to them. On the contrary, as it is obviously found in the oral tradition of many societies, there are many proverbs that undermine Oromo women in general. However, most of the researchers focus on proverbs undermining women than investigating proverbs praising women. It is, therefore, with this input that the researcher is initiated to explore the Oromo proverbs stating women's positively as well as negatively to fill the gap.

## **2. Review of Related Literature**

### **2.1 Proverbs**

Proverbs reflect African common ideas, themes, suppositions, and truths; they also reveal creations (values) unique to and differentiated by ethnicity, socio-cultural, and geographical factors (Courlander, 1975). Therefore, it necessitates defining them in accordance with their own properties that differentiate them from the rest of folklore genres. Finnegan, (1970) and Sumner, (1995) have claimed the attempt to define a proverb to be so difficult and that there is no clear cut definition of a proverb. In spite of this claim, many scholars including these two have defined it in different ways. This widely varied sense of definition is of course initiated by the popular functions they serve in society. Below are some of these definitions.

Finnegan defined a proverb as a saying which has got a fixed form and known by its brief, meaningful and flavorful nature that has the popular acceptance of the realities communicated in it (1970), whereas Achebe, (1974) has related proverbs with a 'palm-oil' to indicate that proverbs are the spices of a speech, through which people exchange a different variety of issues (messages) using few words. The Oromo also have expressed the idea of 'palm-oil' in their proverb, "dubbiin makmaaksa hinqabneefi ittoon soogidda hinqanbne hinmi'aawu." which means 'a speech without a proverb and a stew without salt are tasteless.'

Okpewho, (1992. P.226) has defined it as, "...a folk wisdom expressed with terseness and charm." The "terseness" implies a certain economy in the choice of words and sharpness of focus, while the "charm" conveys the touch of literary or poetic beauty in the expression. Parallel with this point, the Oromo proverb is said to be framed in brevity, where metaphor, symbolism, satire, irony, and the like are concentrated within a single line of a proverb (Eshete, 2007).

Others defined a proverb as: "short and pithy sentences forming a popular saying, and expressing some results of the experienced life in a keen and lively fashion."; Coyle (1991,p.80); "A short pithy saying which embodies a general truth. It is related in form and content to maxims and aphorism." (Cuddon, 1982, p.539).

All the above definitions given by different scholars show the various characteristics of proverbs in common such as short, brief, withy, the popular saying, terse, pithy, flavorful,...etc. are some of the different terms these scholars used to refer to proverbs. Hence, since it is difficult to have the exact and real definition of a proverb, in general, it is better to call it a noble genre of especially, African oral tradition in general and Oromo oral tradition in particular, which carries the wisdom of a people, that has been distilled from experiences made over centuries.

#### **2.1.1 The Functions of Proverbs**

Regardless of their difference in time and place, proverbs which are short and witty expressions are similar all over the world. This is mostly because of the fact that people are fundamentally and psychologically the

same regardless of their continental and color differences (Bascom, 1992; Sumner, 1995; Finnegan, 1970). This can imply that proverbs like their similarity across different cultures also have similar functions.

The reason for the similarity of the proverbs according to Sumner, (1995, p. 53) is the fact that human experiences are almost similar. To use Sumner's words, "Love, sad, death, hunger and fear are the basic factors that rule mankind, primitive or cultured; are factors uninfluenced by environment or civilization." Similarly, many authors indicated that in most traditional African societies proverbs may serve similar functions, even in nearly the same meanings that are different only for their actual context of performance than due to their content and attitude (Lindfors, 1977; Finnegan, 1970; Ben Amos, 1975a). However, as far as purposes of use can be different based on the variation in context within which they are performed, it is important to treat the function of Oromo proverbs in their own socio-cultural context

Like most African people, the Oromo also have a great value for their proverbs in that they compare it with a salt in a stew in the same manner that the Igbo society compares with the palm-oil, and the Chaga who indicated this in their proverb, "Have four big possessions: land, cattle, water and proverbs" (Finnegan, 1970. p. 413). Regarding the value the Oromo have for their proverbs, Sumner wrote: "Since the beginning of my ministry among the [Oromo] populations, I have been struck by the importance given to proverbs by these people, who made a vast usage of them." He added that the proverbs then, stand as a storehouse of the accumulated experience, knowledge, and philosophy of the people." Evidently, therefore, the Oromo do not appreciate their proverbs for anything.

Besides the major functions of proverbs mentioned above which are also the functions of other folkloric forms Finnegan (1992) put the functions of proverbs into two and these are the didactic and aesthetic functions.

#### **2.1.1.1 Didactic Functions**

Didactic functions of proverbs imply the educative functions through which proverbs express, promote, and recognize the beliefs and customs; care for and reinforce morality and tradition by giving them higher value Chesaina (1997), Miruka (1004), Bascom (1965). Taddese (2004,p. 46) has illustrated this in his thesis: "Thus, its art both material and moral, inspirations and frustrations, customary practices, social norms, in short, the sum total of its realities of life can be observed and learned through proverbs. In doing so, proverbs play the role of bridging the past socio-cultural values to the present ones."

Besides its function of cultural continuity in promoting beliefs and customs, the didactic function of proverbs serves people to teach morals, diligence, and purity and, ridicule laziness, snobbishness, immorality, rebelliousness, and other evil behaviors Finnegan, (1992) and Miruka, (1994). That's why, in the case of Oromo people, (especially elders), they often use proverbs and other genres to teach their children about their past, honesty, politeness, faithfulness, and to criticize inappropriate behavior in general. This shows that the educative function of proverbs is widely common among the Oromo too.

### **2.1.1.2 Aesthetic Functions**

Aesthetic as the name speaks has something to do with beauty. In the above context, the beauty is particularly that of communication or speech. To indicate the beauty proverb adds to speech, the Oromo use the proverb “Dubbiin mammaaksa hinqabneefi ittoon soogidda hinqabne hinminyaa’u.” which means ‘a speech without a proverb and a stew without salt are tasteless.’

What is implied in the above proverb is the aesthetic value of proverbs in communication.

Finnegan (1970) and Sumner (1995) have pointed out that proverbs have no separate social condition for their performance. But, they can be used in speech and action at any time, and therefore, are not meant for recreation or entertainment. Thus, the aesthetic function is attributed to the concept of palm-oil in the Igbo and the salt in a stew in the Oromo, where proverbs are used to give color and pragmatic force to formal discussions and an ordinary conversation.

### **2.2 Women in Oromo Proverbs**

Proverbs are free for any person to utter and to listen to but it is a false assumption that only male elders are entitled to use proverbs. The authors called it a false assumption, since, in almost, all community ceremonies, proverbs are used. But it may be noted here that according to Sena’s (2008) study the traditional assumption is that older people (men) are considered to be experts in the use of proverbs.

Oromo proverbs are like any other African Proverbs and forward roles in the depiction of women. Of course, as pointed out earlier in the preceding section, proverbs are expressions of wisdom acquired through reflection, experience observation, and general knowledge. This is also true in the case of Oromo proverbs (Sumner, 1995). Proverbs are intimately related to the culture of a given society. Thus, proverbs could be a major source to examine the image of women in Oromo society.

### **2.3. Feminism**

Feminism is a term that has acquired a number of different meanings. It can be defined as a shared reflection and advocacy of equality between men and women ([www.wlv.ac.UK/ale180femin-htm](http://www.wlv.ac.UK/ale180femin-htm)). For Richards, on the other hand, feminism is the full social, political, and economic equality of women and men. It is also stated by Guerin, et. al. (1998), as feminism aims at disclosing the patriarchal system together with its resulting hatred towards women and evaluates the social, cultural, and psychosexual manifestation of literature and literary criticism.

Feminists’ aim is to promote and encourage a female’s tradition of writing; to interpret their literary works in order not to be ignored by the male point of view; to rediscover old texts; to analyze female writers and their works from the female point of view; to fight sexism in literature; and to increase awareness of the sexual politics of language and style (Guerin, et al. 1998). Therefore, the feminists’ movement is engaged in the wholesale attack against the sex-role stereotypes, and their consequences. In fact, (Lewis, 1974) <http://www.jstor.org>) confirmed this saying, “The function is revolutionary: the aim is to activate and to



initiate change...” And besides this, she indicated that the feminist’s movement has utilized folklore material, applying it to the struggle for female equality.

According to many feminists, changing the old history through awareness creation among the society and revision of images in the past will lead to the solution. Farrer, (1975), assures this idea as, “The consciousness of men as well as of women was raised by feminist literature and this led to the current revival of interest in women’s rights in all aspects. In short, a look into feminists’ view patriarchal system together with its resulting hatred towards women and evaluates the social, cultural, and psychosexual manifestation of literature and literary criticism can help in the process of searching for a solution to gender-biased attitudes and women’s invisibility in society. So in the theme of Oromo proverbs let us look at what way women expressed and its effect too.

### **3. Method of the Study**

The study is qualitative research, it comprises textual analysis methods together with relevant conceptual tools and frameworks and therefore it is analytical. Different books in which novels are documented have been read and examined critically. According to Abiy (2009), qualitative research involves and seeks to describe various aspects of behavior and other factors studied in the social sciences and humanities. In qualitative research data are often in the form of descriptions, rather than numbers. Document analysis, the process of using any kind of documents, can be used as a methodology in qualitative research as a singular method of research or as a supplementary form of inquiry. Hence textual analysis method is the best fit with the objective of the research since the main focus of the research is analyzing the theme of Oromo proverbs said for women.

Purposive sampling technique is used to select the proverbs documented in different books that represented women. The proverbs selected were specific for women and they are considering both positive and negative expressions. The study employs secondary data. The secondary data and the main focus of the research were on the proverbs documented in different books that are related to women. This has been done because of the inconvenient situation created by COVID-19 to collect data from the first hand through filed work.

After the data collection translation is taking place. The data was translated from the original language Afaan Oromo to the target language English. Then classification took place based on its content and analyzed thematically using qualitative method. Finally, interpretations were given based on different theories and literature.

### **4. Analysis and Discussion**

#### **4.1 Proverbs Said for Women Positively**

Some proverbs indicate that women are more valuable than men. They describe women as life bearers, nurseries, cherishers, and they care for life since all human life passes through their wombs. Let us see proverbs positively expressing women as mothers and wives.

#### **4.1.1 Women as a Mother**

There are proverbs that have depicted women as lovable, generous, and tolerant (Berhanu, 2008). Some proverbs consider women the most important member of the family. For instance,

Namni haadha qabu nama Waaqa qabu  
The one who has a mother is the one who has God

From the proverb, the value of a mother is expressed as God. This shows how much mothers are valuable and respectful in Oromo society. Truly speaking it is difficult for all of us to express the value of mothers using any word less than in the proverb stated. Mothers are very important in any family and the base for human life continuity.

Haadha dhabuu mannaa, haadha dhabduu wayyaa  
Having a destitute mother is better than not

The proverb says 'Haadha dhabuu mannaa, haadha dhabduu wayyaa' shows that mother is greater than everything. According to this proverb, psychologically somebody who has a mother is not equal to someone who does not have a mother.

Haadhaa fi lafatu nama danda'a  
Mother and ground hold everybody

The proverb depicted that both mother and land have enough resistance to hold any good and bad things such as happiness, sadness, traits, ill-behaviors, and so on of somebody. Mother can correct her sons' ill-acts and ill-doing because she is a mother. When we look at the behavior of land, it has no negative response for any person whatever the person or his did is. In a similar way, a mother not responds negatively to her child whatever they and their behavior is. She is always looking for her child as a correct person and kid. That is why the Oromo proverb says 'mother and ground hold somebody'.

Haadha duute mannaa, haadha maraatte wayya.  
Mad mother is better than a dead mother

According to this proverb, let alone a healthy mother, even the existence of a mad mother is better than not having a mother at all. Even though she is not healthy the presence of her mother gives mental satisfaction. From the concept, the mother who didn't give any support for her family has a good place for her child. The relationship between mothers and children is not connected in advantage; it is innate.

In short, despite the fact that such proverbs play their own role in the process of the socialization of the biased attitudes of a given society towards the image of women as mothers is positive and the people also

use them exactly to mean what the proverbs say about mothers. This idea goes in line with the works of different researchers like Jaylan, (2005).

#### **4.1.2 Women as a wife**

In the proverbs of Oromo society, women are depicted both positively as a wife in similar to mothers. Below are a number of proverbs that depict women positively.

Nyaanni soogidda malee, manni dubartii malee hin bareedu.

A house without a woman is like food without salt.

The proverb “a house without a woman is like food without salt” shows how much women are important in the house. It describes a house as a test less and values less entity without the presence of women. So, women give meaning for meaning fewer affairs when they are present in the home. According to Ethiopian cultures specifically, Oromo’s males and child are not interested to be at home when mothers are not there. As the food without salt is not swallowed for every one of us, the house also not give happiness without women.

Niitiin utubaa manaati

A wife is the pillar of a house

When we look at a house, every part of the roof is laying on a pillar. It holds every aspect of that house and makes to stand in an appropriate way. If that pillar lacks its strength the house became useless and became destroyed. The proverb “a wife is the pillar of a house” depicts a similar idea by replacing women with house pillars. This indicates that most of the family responsibilities are handled by women. This can be started by giving birth. She carries a baby in her womb for nine months and three years in her hands. Also, she has responsibility for all home duties and management. The men responsibility is out-door. Therefore, the strength of given family life is measured through the wife's strength; if she is good the family will be good if not vies-versa.

Dubartiin faaya manaati

A woman is a jewel of a house

This proverb also portrayed the importance of women in the house. Her women are described as an ornament. Which is very valued and expensive, the jewel is not used by any layperson since it is costly. The place given for women is like an ornament that every person cannot deserve. As we keep our jewel at a very ideal place women also imagined like that by Oromo society. It is a very respectful and great consideration for women.

Generally, all of the above proverbs show how much women are important in house holding. In the proverbs, women are depicted to be very important members of the community, especially for their husbands. As far as the skill of housekeeping and feeding a family is solely the duty of women in many patriarchal societies, it is not surprising if women expertise in this area and are praised and appreciated for

their good performances. Similarly, from these proverbs, it is possible to deduce that everyone performs well, activities at which she/he has experience for a longer period of time. That is, women, as they were trained to perform reproductive works at home, they are excellent at the field while men were trained to perform productive works outside the home, they are excellent or very good at their field too.

Therefore, had it not been for the biased desire of the patriarchal society to put women under the subjection of men, the above fact by itself should have led them to the construction of the attitude that women and men are two complementary elements of a community, not inferior or superior to one another. Besides, these proverbs are considered to be the positive portrayals of women only when they are seen from the angle of their literal meaning and under the conditions where this improper and biased work division is internalized as a normal one.

Otherwise, like that of motherhood, all the proverbs show women's identity not as an individual, but in terms of their importance to men and, they still facilitate the conditioning of women's character to internalize the socially constructed domain and status of women. Hence we can consider these proverbs as examples of a positive portrayal of women if and only if the proverbs were used by the people to praise good performance and to reward the behavior for further motivation being unconscious of its adverse effects on the other extreme.

## **4.2 Proverbs Said for Women Negatively**

### **4.2.1 Disrespecting Women**

As there are proverbs that express valuableness of woman as, mother and wife, there are also proverbs which portray woman negatively. Some proverbs are completely against women. Let us see some examples,

Uleefi dubartiin jilbaa gaditti

A stick and women are better when they are handled below the knee

This proverb shows the superiority of men over women. To handle and control women keeping them under the knee is taken as a good way of management. This can be practiced by protecting their right to speak, be out of the house, take responsibility for the economy, make decisions on their family's life and etc. This is because women are disrespected and seen as ignorant to participate in such key issues. So, the idea is blocking access by controlling them not to be out of the power and management of men.

Dhaltuun fardaafi dubartiin ulfina hinbeektu

A female horse and a woman do not know respect

As it is indicated in the above proverb, women are symbolized as a female horse which is an animal. It shows that since women do not know respect it is not necessary to respect them. Here women are assumed as ignorant of respect which is totally opposing their behavior. The knowledge of respect is not given for

some groups or sex; it is a common character for all human beings. From the concept of the proverb, one can easily deduce how much women are undermined by society.

Nadheeniifi faradeen galgala baddi

Women and a horse are helpless at the old age

From the proverb women, life became bad at their old age like a horse. This means that one can use them at their young age or when they are strong and through when they lose their energy. Here women are taken like an animal that serves human and explained as they are useless at their old age. So, women are supported by men when they are serving them and became helpless at old age. The idea is women are not stand by their self and they are dependent on the men up to the time they can give service. But when we look at its practicality, it is completely not, because women in general Oromo women, in particular, are not such weak and completely dependent on men. Such proverbs are used by men to make women see themselves as incapable people and to give them service for a lifelong.

The contribution of these proverbs to the construction of negative images of women is that being used repeatedly, they condition women themselves to accept as normal, the biased attitude the society has towards them and to act accordingly. In this case, they are trained to accept that they are inferior to men and should take a lower and inferior position in their community.

#### **4.2.2 Women as an Ignorant**

In similar to other negative expressions, Oromo proverbs also express women as ignorant. Let we see some examples,

Dubartiin beektuu hinqabdu beekaa deessi malee

A woman is not intelligent, but she gives birth to the intelligent ones

From the proverb, women are not brainy, but they give birth to the brainy ones. The assumption is there are no intelligent women at all so women are totally ignorant. It implies that these intelligent persons are men or males; addressing women's inferiority to their people. But, the reality is far from this idea. As we all know there are a lot of intelligent women across the globe that performs every activity equal to men. Being intelligent is not sex-based; it is common for all as a human being.

Beekumsi dubartii dinqaa olitti

Women are intelligent in the door

The proverbs reveal women and men in different positions, one as the possessor of this oral treasure, proverbs, and others as an oppressed group. The place given for women is in the door which is 'Dinqaa' the section of a room where women put articles, dishes, and other service materials for food. In Oromo society, this section of the room is not allowed for men. So, women are good at cooking and giving other

home services but not in fieldwork. Still, the practical life of Oromo women is not revealing the idea; they are good both in the door and out of the door.

Dubartiin dheertuun dhuma midhaanii hinbeektu

A tall woman does not know the end of the grain

This proverb is to show that the tall woman reaches the grain in the storage easily and gets enough amount of grain for family daily consumption. As she frequently does it, the grain would be finished. Because, there is no problem with her accessibility in relation to her height to the grain, in doing so, she only understands it when it is already empty. This implies that since women are ignorant they have no care for tomorrow and think over what they are doing.

## **5. Conclusion**

Proverbs are one among the genre of oral literature which reveals human social life and world outlook of a specific community. Depending on the characteristics of proverbs; it is possible to comment on the social roles, community roles, sex roles, and individual roles in power relationship structures among human beings. Gender inequality is the denial of equality between men and women which is reflected through cultural trends by using proverbs. Briefly, in the proverbs, there are images of women, men, and community. The world outlook of life, philosophy, and ideology, in general, can be revealed by proverbs of a particular community, but also deep inequality. Thus proverbs are used as a system of inequality delegation between men and women. In general, from the proverb analyzed and interpreted the subsequent conclusion is made:

In Oromo proverbs, women are portrayed both positively and negatively, and the image of a mother and wives are positive. They are represented as excellent house makers and obedient servants of their family. Here, it is important to note that almost all proverbs positively said for women are about their efficiency in the home and not in fields or external duties out of the home. Besides, it was found out that such an expression makes women themselves to accept the inferior position they were given in their society and influence them to act according to the social code of conduct.

This study also found out that women are perceived negatively and disrespected in Oromo proverbs. From the result, male dominance and the inferior position, and the low status of women are clearly observed. In these proverbs, women are revealed as ignorant, dependent, weak, irresponsible, unpredictable, and as inferior members of their community.

In general, the actual characteristics of women are considered as nothing and ideal behaviors are disseminated in proverbs and in cultural trends. Proverbs are glorifying the men's esteem at far distances from women and deny women entire human rights under the coverage of "unquestioned norms". Women are considered as nothing in human social life, like an institution, economic, political, and socially in the



use of proverbs sphere as they are unknowingly consenting to the violation of their human rights. Proverbs are used as cultural tools to conduct oppression and domination and dominate one group of persons, women. Proverbs are portraying women as a social asset that every male can use as much as cultural trends permit them. Most of the proverbs are comparing women with animals like horses and symbolize the bad character.

The transmission of these proverbs has a contribution to the perpetuation of the negative images of women and this causes women's negative self-image and their low participation in different social affairs in their community. Therefore, educating women, giving awareness creation training about women's equality to the society, increasing women's participation, and discouraging the use of the proverbs that socialize the inferior status of women may be a solution to create a positive image of women in society.

## References

1. Abiy Zegeye (2009). *Research Methodology*. Addis Ababa: Addis Ababa University Press.
2. Achebe, C. (1974). *Arrow of God*. London: Heinemann.
3. Barbro K. Folklore. In *International Encyclopedia of the Social and Behavioral Sciences*. Volume 8. Pp. 5711-5715. New York: Elsevier, 2001.
4. Bascom, W. (1965a). Folklore and Anthropology. – In Dundes, A. (Ed.). *The Study of Folklore*. N. J.: Prentice Hall, Inc.
5. \_\_\_\_\_ (1992). *African Folktales in the New World*. Bloomington and Indianapolis: Indiana University Press.
6. Ben Amos, D. (1975a). *Folklore in Africa Society; Research in African Literature*. Angola: Nigeria: African Book Publishing Record.
7. Berhanu, B. (2008). *The Portrayal of Women in Folktales and Popular Sayings of the Oromo of East Wallega*. (unpublished M.A Thesis) Addis Ababa University Department of Foreign Language and Literature.
8. Chesaina, C. (1997). *Oral Literature of the Embu and Mbeere*. Nairobi: East African Educational Publishers.
9. Courlander, H. (1975). *A Treasury of African Folklore; The Oral Literature, Traditions myths, legends, epics, tales, recollections, wisdom, sayings and humor of Africa*. New York: Crown Publishers Inc.
10. Coyle, M. (1991). *Encyclopedia of Literature and Criticism*. New York: Rutledge.
11. Cuddon, J. A. (1982). *A Dictionary of Literary Terms*. Penguin Books.
12. Dorson, R. (Ed) (1972). *Folklore and Folk life: An Introduction*. Chicago: The University of Chicago.
13. Eshete, G. (2007). *African Society and Egalitarian Values; Oromo folklore literature and cultural studies in contemporary context*. (Unpublished PH. D. dissertation).
14. Finnegan, R. (1970). *Oral Literature in Africa*. Nairobi: Dar Es Salaam: Oxford University Press.
15. \_\_\_\_\_ (1992). *Oral Tradition and Verbal Arts*. London: Rutledge

16. Guerin, W. L. (1998). *A Hand Book of Critical Approaches to Literature*. 4th Ed. New York: Oxford: Oxford University Press.
17. Jaylan, W. H. (2005). *The Function of African Oral Arts; The Arsi Oromo oral arts in focus*. African Study Monographs, 26(1), PP. 15-58.
18. Lewis, M.E.B. (1974). *Feminists have done it: Applied Folklore*. Journal of American Folklore, Vol. 87. No. 343 PP. 85-87. <http://www.jstor.org/journals/folk.html>.
19. Lindfors, B. (1977). *Forms of Folklore in Africa; Narrative, poetic, gnomic, dramatic*. Austin and London: University of Texas Press.
20. Miruka, O. (1994). Understanding and Teaching Proverbs. - In Bukenya and (et al.) (Eds.) *Understanding Oral Literature*. Nairobi: Nairobi University Press.
21. Ndungo, C. M. (1993). The Images of Women in African Oral Literature; A case study of Gikuyu Oral Literature, - in Mesfin, a. and Abiye, D. (2006). *Gender Issues Research Report Series*. No. 23 PP. 1- 80 Ethiopia: OSSREA.
22. Okpewho, I. (1992). *African Oral Literature; Background, character and continuity*. Bloomington and Indianapolis: Indiana University Press.
23. Sena Gonfa. (2008) *The Image of Women in the Proverbs and Saying of the Oromo: the case of West Arsi Zone* (unpublished M.A. Thesis) Addis Ababa University Department of Foreign Language and Literature.
24. Sumner, Claud. (1995). *Oromo Wisdom Literature*. Vol.I. Addis Ababa: Guddina Tumsa Foundation.
25. Taddese, J. (2004). *A Contextual Study of Guji Oromo Proverbs; Functions in focus*. (Unpublished MA. thesis). A.A.U. Department of Foreign Languages and Literature.
26. D'angelo, (<http://links.jstor.org>.)
27. ([www.wlv.ac.uk/ale180femin-htm](http://www.wlv.ac.uk/ale180femin-htm)).

### **Abstract**

The COVID-19 pandemic has had a profound effect on both education and research activities. A survey conducted within the geotechnical engineering and earth science academic communities between April 22 and 24 explored the variables that affect working efficiency and intellectual development during the pandemic period. We received 274 complete responses from faculty and graduate students in North America, Europe, South Korea, and Saudi Arabia. The four variables that correlate best with individuals' perceived consequences of the pandemic are: setting daily goals, focus on academic tasks, time spent reading literature outside core research or on professional development, and commitment to exploring deeper scientific concepts. Overall, 28% of the respondents exhibit a positive outlook. For the other 72%, living with non-family members or with children, hindered access to needed materials, and excessive time spent with video entertainment exacerbated the perception of potential negative consequences of the pandemic. Observed percentages and trends are very similar across age, gender, living conditions and regardless of regional/national restrictions. Two complementary surveys addressed faculty choices for online education and student preferences. These results document the effective transition from in-person to online education using readily available technology, and highlight students' preferences for in-person education followed by live online platforms; pre-recorded lectures emerge as the least preferable choice.

*Keywords:* COVID-19, working efficiency, intellectual development, academia, online learning, survey

## **Academia During the COVID-19 Pandemic:**

### **A Study within the Geo-Science and Engineering Field**

Pandemics have affected and shaped societies for millennia, including the Antonine plague (between 160 and 189 AD; Sabbatani & Fiorino, 2009), the bubonic plague (14<sup>th</sup> century; Stenseth et al., 2008), Spanish flu (1918 – 1919), and more recently HIV aids, the ebolavirus, SARS and swine flu (LePan, 2020). Typically attributed to urbanization, transportation and migration patterns, geopolitical and demographic changes, and the adaptability of microorganisms, pandemics appear to be increasing in frequency (McMichael, 2004; Destoumieux-Garzón et al., 2018).

The current global COVID-19 pandemic has forced the international academic community to reconsider educational delivery and assessment methods, advance research without laboratory access, and to maintain academic interactions online with both students and colleagues. Recent large-scale surveys of university students during the COVID-19 period have examined the impact of the coronavirus on student study plans, university responses to the crisis, attitudes and experiences of online learning and student mental health. In Europe, 66% of students report difficulties in maintaining their concentration during online learning, over half perceive that they are not progressing as effectively as they would on campus and indicate that isolation negatively impacts their motivation (Tormey et al., 2020). Results from China suggest that economic uncertainty, academic changes and social distancing measures have caused increased student anxiety (Cao et al., 2020). As the duration of the pandemic extends, its effects become deeper and more apparent throughout the scientific literature. For example, comments and opinions in the journal *Nature* during April capture the impact of this period on academic productivity (Minello, 2020), logistical challenges (Paterlini, 2020) and the importance of maintaining connections and advancing research despite physical distance (Bardelli, 2020).

This paper explores the impact of the COVID-19 pandemic on academic and daily activities in four distinct geographical areas. In particular, we seek to identify the variables that affect working efficiency and intellectual development during the pandemic.

## **Methods**

### **The Survey**

The main survey consists of 20 multiple choice questions and two open-ended questions hosted on Survey Monkey, ("SurveyMonkey", 2020 - The survey appears in Appendix 1). The first four questions span basic demographic information, followed by ten questions that aim to provide a snapshot of respondents' lives during the survey period. The subsequent four questions require respondents to compare some elements of their situation during the pandemic and before restrictions started. The last two questions ask for estimates of the impact of the pandemic on their research and intellectual development and on their careers. The survey concludes by inviting respondents to share any insights regarding the impact of the coronavirus pandemic on their lives.

### **Respondents**

Survey links were emailed to faculty and graduate students in the geotechnical engineering and earth science academic communities in North America (Canada and the USA), Europe (primarily Belgium, Italy, Spain, France, the UK, Germany and Switzerland), South Korea, and King Abdullah University of Science and Technology KAUST in Saudi Arabia. Distribution benefitted from research networks, thus the number of people who received the survey links is unknown. We used the same survey but with four different links to discriminate answers according to geographic zone. All responses remained anonymous and there was no incentive provided for participation. The survey remained open for 48 hours.

### **Time and Context**

The survey took place during April 22 to 24. Local restrictions at the different locations during the survey period ranged from "minimal changes to daily life" (South Korea), "some changes to daily life" (Switzerland, Germany), "partial lockdown" where employees are required to work from home, with travel limited to essential grocery shopping and medical appointments,

and where outdoor exercise may be permitted but with some restrictions (Canada, France, Belgium, England, KAUST in Saudi Arabia, and in some parts of the USA), and “total lockdown” restrictions on all but essential movement, including outdoor exercise (Italy and Spain).

The number of coronavirus cases and deaths varied throughout the four areas, as shown in Figures 1a&b. Contrary to reports in the media that tend to highlight the total counts in a given country, data in these figures are normalized by the corresponding country’s population to reflect the probability of individuals being directly affected by a case within their immediate circles.

The pandemic and ensuing restrictions had a rapid and pronounced effect on the economic system. For reference, Figure 1c shows the drop in the stock market, represented here by the Dow Jones Industrial Average DJIA, and the fast rise in unemployment claims. The survey took place during the fifth week after the lowest point in the DJIA, while the high continued unemployment claims made daily news.



## Results and Analyses

We received a total of 274 complete responses out of 304 respondents from Europe (153), North America (55), South Korea (21) and KAUST (75). Figure 2 presents the age break-down of all respondents. They are predominantly male (with the smallest proportion of female respondents from South Korea 4%), and only 30% live with children. Most respondents are between 26 and 40 years old (67%). Given the age distribution, we anticipate about half are graduate students and the remainder postdoctoral fellows, research scientists and faculty members.

### Main Variables, Predictive Model

Answers to the last three multiple choice questions provide a direct self-assessment of individuals' perceived consequences of the pandemic: (Q18) compares the effectiveness in research or study tasks during and before the pandemic, (Q19) the perceived effect of the pandemic on research and intellectual development, and (Q20) the anticipated effect on career path and timing. Histograms in the first row of Figure 3 summarize the responses to these 3 questions according to geographic origin. There is an overall negative balance, and respondents are 2.5 times more likely to report a decrease rather than an increase in efficiency and a negative impact on intellectual development as a result of the pandemic.

On the other hand, a comprehensive correlation analysis helps us to identify potential causal links. The four variables that emerge as the strongest predictors of individuals' perceived consequences of the pandemic are: (Q6) setting daily goals, (Q7) ability to focus on academic tasks, (Q13) time spent reading literature outside core research or on professional development, and (Q17) commitment to exploring deeper scientific concepts. Histograms in the second row of Figure 3 summarize the responses to these four questions colored by geographic origin. The most negative causal variable is diminished ability to focus. Once again, overall trends show significant parallelisms among responses from different countries.

We use a multivariate analysis to develop a predictive model that relates the effects of both

personal and professional factors on the perceived impact of the coronavirus period. The model combines the main variables identified above into “**causal**” variables and their “**effect**” on individuals’ perception as follows (Note: this analysis requires converting verbal responses and ratings to a numerical scale; adopted values are shown in Figure 3 but were not visible to respondents):

$$\begin{aligned}
 \text{cause} &= [ 1 \quad (\text{daily goal}) \\
 &+ 5 \quad (\text{ability to focus}) \\
 &+ 2.5 \quad (\text{emphasis on personal development}) \\
 &+ 1 \quad (\text{commitment to exploring deeper concepts}) ] / 12.5 \\
 \\
 \text{effect} &= [ 2.6 \quad (\text{change in research effectiveness}) \\
 &+ 1.3 \quad (\text{perceived effect on research and intellectual development}) \\
 &+ 0.8 \quad (\text{perceived effect on career path and timing}) ] / 9.4
 \end{aligned}$$

The plot in Figure 4 shows the **cause** and **effect** data point for each respondent. Note that 72% of all respondents have a negative perception about the potential consequences of the pandemic ( $\text{effect} \leq 0$ ). The trend between **cause** and **effect** has a high coefficient of determination  $R^2 = 0.59$ . The ‘ability to focus’ (Q7) may be considered a consequence rather than a cause; if this variable is removed from **cause**, there is still a marked correlation, but the coefficient of determination falls to  $R^2=0.38$ . Overall, trends are statistically similar for the different geographic regions.

## Other Variables

Weak predictors of a positive outlook during this period include male gender (a slightly more positive outlook than women), planning weekends differently to weekdays, significant time spent writing technical documents, and age between 31 and 40 years. Variables associated with a more negative perception are (albeit weakly): living with others (not family), living with children, hindered access to materials needed to work from home, and limited time devoted to reading literature outside the core research area (less than 30 minutes per day).

While some variables have a low correlation with perceived consequences, they still provide valuable information. For example, those who live with family members are 1.4 times

more likely to feel less effective in research or study tasks than those who live alone. In particular 63% of women and 54% of men report a decreased focus on academic tasks (Note: more men report living with children than women in this group). Respondents who exercise less than 30 minutes per day are 2.5 times more likely to report being less efficient than those who exercise for at least 30 minutes each day. In addition, those that watch more than one hour of TV/movies/videogames per day have a 2.5 chance of reporting being less effective at the time of the survey than before the pandemic.

### **Responses to Open-ended Questions**

We received a high level of responses to the two open-ended questions, identifying both negative and potentially positive consequences of this period. Common negative affects relate to diminished job and career prospects, the associated financial concerns and overall uncertainty about the future; these responses are consistent with economic indicators during the survey window (Refer to Figure 1-c). Other concerns address the decrease in ability to maintain focus, setback in experimental work, the impact on mental health (including exacerbation of pre-existing mental illness), and loneliness. On the other hand, a frequent positive comment, common to all geographic and age groups, was that the pandemic period has given individuals the time to think and reflect on what is important – both personally and professionally.

## **Complementary Surveys**

Two additional short surveys compliment the main survey summarized above and address institutional and faculty choices for online delivery, and students' preferences.

### **Faculty: Technology**

The first dataset identifies both the online platforms used for distance learning and the preferred technologies selected by faculty during the rapid transition from in-class to online teaching during the early stages of the lockdown. This survey was conducted during the first week of April 2020 and explored online delivery methods, technology, exams and grading systems. The 16 geotechnical professors represent universities in Argentina, KSA/KAUST, South Korea, France, Switzerland, UK and the USA. Faculty deliver live online content, pre-recorded lectures and tutorials using various online platforms including Google Meet, Moodle, Weblearn, Microsoft Teams and Canvas, Discord, YouTube, Zoom, BlueJeans, Kaltura and Canvas, and Zoom. A common strategy involves sharing files with students. In general, faculty report high student satisfaction with online content that focuses on case studies, however they note students fatigue after about four hours of remote learning per day.

### **Students: Lecture Style Preferences**

The second complementary survey examined the preferences of KAUST graduate students in geoscience for lecture delivery styles and took place at the end of the semester, between May 20 and May 23. The majority of the 34 anonymous respondents had transitioned from in-class to online education during the past semester. The survey asked respondents to rate the various lecture delivery styles: (1) in person, (2) live online (e.g., via Zoom), and (3) through prerecorded online videos (e.g., Youtube). Finally, it encouraged respondents to share underlying reasons for their preferences and recommendations to improve the overall experience.

Figure 5 shows histograms for the three set of responses. "Good" and "Very Good" account

for 85% of the responses for in-person delivery, 58% for live online, and 39% for online pre-recorded. Respondents who prefer in person lectures frequently note the benefits of personal and direct interaction with the faculty and other students; enhanced concentration, engagement and motivation in a classroom setting; and classes better tailored to the students' needs.

In the case of live online classes, respondents advised faculty to focus on interactions with students and suggested using quizzes as a strategy to increase engagement. On the other hand, they recognized potential benefits in pre-recorded lectures. Besides time flexibility and the ability of students to repeat sections for clarification, prerecorded lectures that occur at a scheduled time with the faculty member available during the class period to answer questions combine positive features of each style.

Overall, these results suggest that there is a clear opportunity for online lectures (either live or pre-recorded). Further developments require technological developments, increased technological proficiency (both faculty and students), and improved delivery styles to interact and engage students to enhance their educational experience.

## Conclusions

The COVID-19 pandemic has tested the academic system worldwide. We have to rapidly transition to new forms of distant communication and online delivery of education, and have to focus on research tasks that allow for remote operation in lieu of laboratory tasks.

This study shows that 28% of respondents managed to find an overall positive outcome to the pandemic. However, the majority anticipate negative consequences on intellectual development and career path. Notably, these percentages are very similar across age, gender, living conditions and regardless of regional/national restrictions.

Variables associated with a more negative perception are: living with others (not family), living with children, hindered access to materials needed to work from home, limited time devoted to reading literature outside the core research area, and excessive time watching TV/movies/videogames. While active physical activity is often recommended to overcome the negative impact of restrictive environments, exercise showed only a minor correlation with efficiency and almost no correlation with individuals' long-term outlooks.

Those who have reacted most positively to the pandemic tend to set daily goals, remain focused on intellectual tasks and on personal development, and spend more time exploring deeper concepts. In fact, several in this group consider this period as a unique time to reflect, identify priorities, explore new concepts and advance great research.

The pandemic prompted the largest experiment on distance learning across the international community. Limited results show a lagging preference for in-person education. However, online education has done well, particularly for live delivery rather than pre-recorded lectures.



## References

- Bardelli, A. (2020). Coronavirus lockdown: what I learnt when I shut my cancer lab in 48 hours. <https://www.nature.com/articles/d41586-020-00826-7>
- Cao, W., Fang, Z., Hou, G., Han, M., Xu, X., Dong, J., & Zheng, J. (2020). The psychological impact of the COVID-19 epidemic on college students in China. *Psychiatry research*, 287, 112934-112934. doi:10.1016/j.psychres.2020.112934
- Destoumieux-Garzón, D., Mavingui, P., Boetsch, G., Boissier, J., Darriet, F., Duboz, P., Fritsch, C., Giraudoux, P., Le Roux, F., Morand, S., Paillard, C., Pontier, D., Sueur, C & Voituren, Y. (2018). The one health concept: 10 Years old and a long road ahead. *Frontiers in Veterinary Science*, 5(14), pp.1-13, doi:10.3389/fvets.2018.00014
- LePan, N. (2020). Visualizing the history of pandemics, <https://www.visualcapitalist.com>
- McMichael, A.J. (2004). Environmental and social influences on emerging infectious diseases: past, present and future. *Philos Trans R Soc Lond B Biol Sci*, 359(1447), 1049-1058. doi:10.1098/rstb.2004.1480
- Minello, A. (2020). The pandemic and the female academic. <https://www.nature.com/articles/d41586-020-01135-9>
- Paterlini, M. (2020). Lockdown in Italy: personal stories of doing science during the COVID-19 lockdown. <https://www.nature.com/articles/d41586-020-01001-8>
- Roser, M., Ritchie, H., Ortiz-Ospina, E., & Hasell, J. (2020). Coronavirus Pandemic (COVID-19). *OurWorldinData*, <https://ourworldindata.org>
- Sabbatani, S., & Fiorino, S. (2009). The Antonine Plague and the decline of the Roman Empire. *Infez Med*, 17(4), 261-275
- S&P Dow Jones Indices (2020). Dow Jones Industrial Average, <https://us.spindices.com>

Stenseth, N.C., Atshabar, B.B., Begon, M., Belmain, S.R., Bertherat, E., Carniel, E., Gage, K.L., Leirs, H., & Rahalison, L. (2008). Plague: past, present, and future. *PLoS Med*, 5(1), pp. 9-13, doi:10.1371/journal.pmed.0050003

SurveyMonkey Inc (2020). <https://www.surveymonkey.com>

Tormey, R., Sarrade I., & Jermann, P. (2020). *Online learning experience questionnaire*. Teaching Support and Center for Digital Education, EPFL, <https://www.epfl.ch>

US Department of Labor (2020). *Unemployment insurance weekly claims data*, <https://oui.doleta.gov>

## **Appendix 1: CORONAVIRUS 2020**

The main survey is reproduced here in its entirety

### **General**

1. Do you live alone, with family or with others?

- Alone
- With family
- With others

2. Do you have children living with you?

- Yes
- No

3. Select your age group

- 18 – 25
- 26 – 30
- 31 – 40
- 41 – 50
- 51 +

4. Select your gender

- Male
- Female

### **A snapshot of your life today during the coronavirus pandemic**

5. Do you plan your weekends differently than weekdays?

- Yes
- Sometimes but not always
- No

6. Do you set yourself a daily goal?

- Always
- Often (4 or 5 times per week)

- Sometimes (2 or 3 times per week)
- Never

7. Has your ability to focus on your study/research changed since the beginning of the pandemic?

- My ability to focus on my work has increased
- No change
- My ability to focus on my work has decreased

8. Has your number of work/study related meetings changed since isolation?

- Increased
- Remained the same
- Decreased

9. Do you have access to all the materials that you need to work/study from home?

- Yes
- No. Please comment.

**How much time do you currently spend every day (think in terms of a weekly average) on:**

10. Physical exercise

- Less than 30 minutes
- 30 minutes – 1 hour
- 2 hours
- More than 2 hours per day

11. Interacting with friends and family (online and in person):

- Less than 30 minutes
- 30 minutes – 1 hour
- 2 hours
- More than 2 hours per day

12. Watching TV, movies and video games:

- Less than 30 minutes

- 30 minutes – 1 hour
- 2 hours
- More than 2 hours per day

13. Reading literature outside your core research or on professional development:

- Less than 30 minutes
- 30 minutes – 1 hour
- 2 hours
- More than 2 hours per day

14. Writing technical documents (theses, papers and reports):

- Less than 30 minutes
- 30 minutes – 1 hour
- 2 hours
- More than 2 hours per day

**Comparing your current situation and your activities before the beginning of the pandemic, are you...**

15. Exercising

- Much less
- Less
- About the same
- More
- Much more

16. Focused on your personal and professional development

- Much less
- Less
- About the same
- More
- Much more

17. Exploring deeper/alternative concepts or theories

- Not really

- About the same
- Much more, decisively

18. Effective in research or study tasks

- Much less
- Less
- About the same
- More
- Much more

**Overall, please assess the effect that the coronavirus pandemic will have...**

19. On your research and intellectual development

- Major negative effect
- Some fall back
- No effect
- Some benefit
- Great benefit

20. On your career path and timing

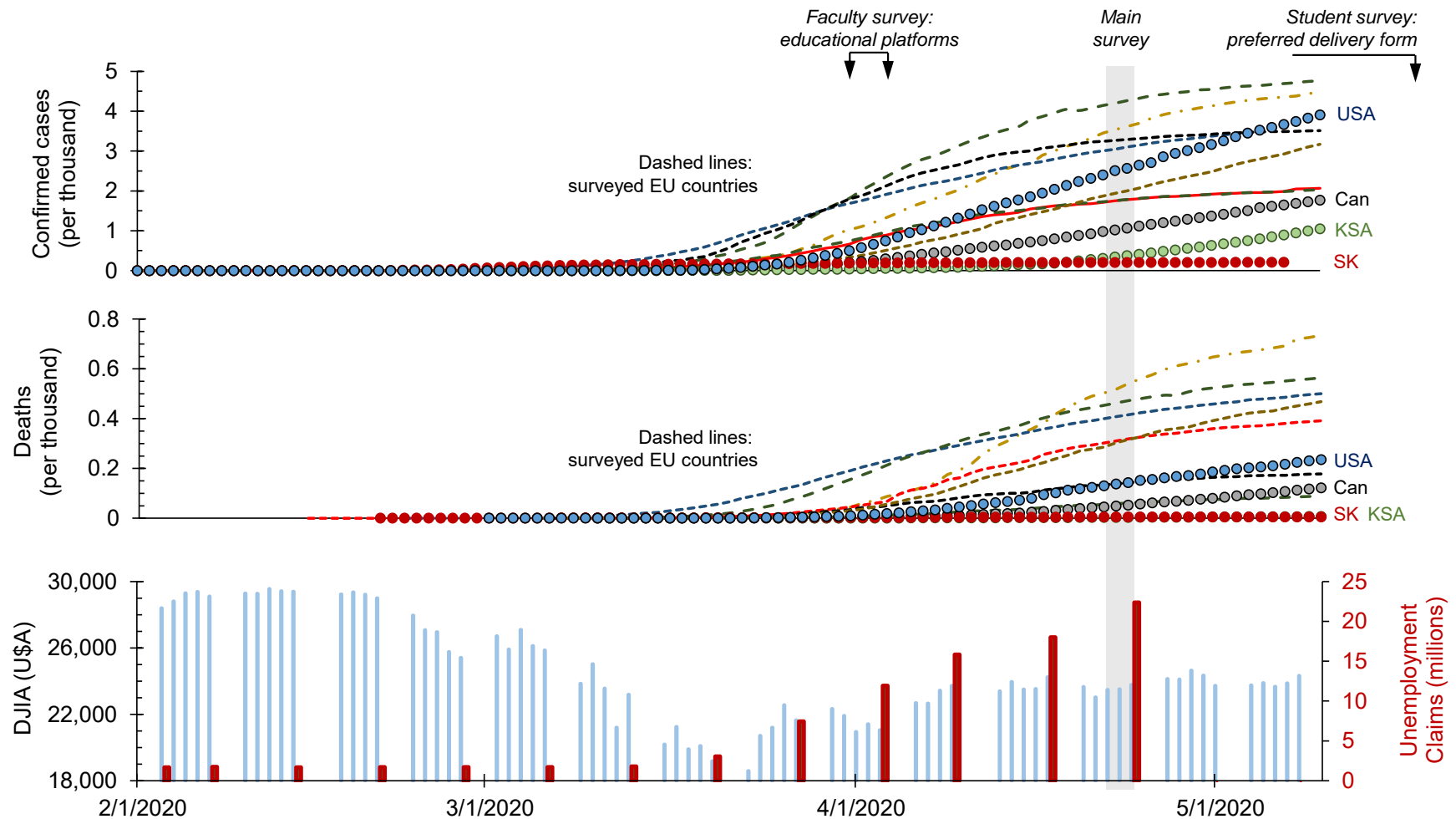
- Major negative effect
- Some fall back
- No effect
- Some benefit
- Great benefit

21. Please feel free to share any insights that you may have regarding the impact of the coronavirus pandemic on your life. Responses will remain anonymous.



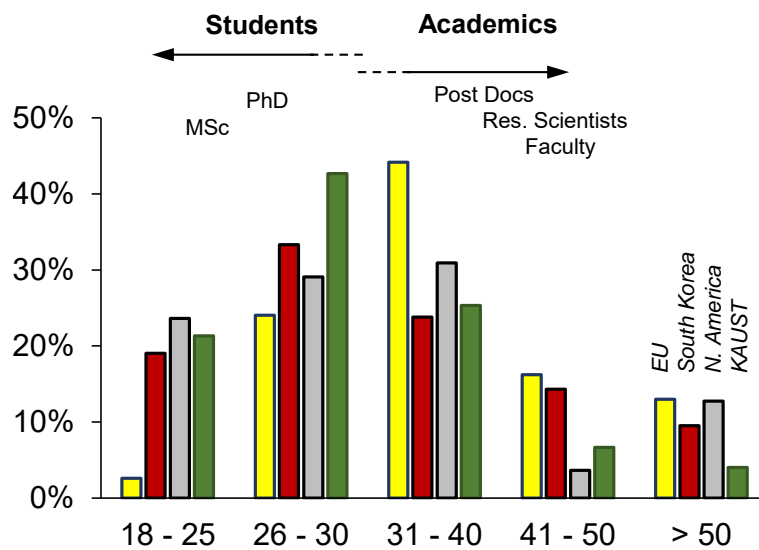
**Figure 1:**

Timeline from January 1 to May 9, 2020 and the surveys' timing. (a & b) Confirmed number of cases and deaths normalized by national populations in the surveyed countries. (c) Dow Jones Industrial Average and US unemployment claims (seasonally adjusted, continued unemployment claims). Data sources: Roser et al., (2020), S&P Dow Jones Indices, 2020, US Department of Labor (<https://oui.doleta.gov>)



**Figure 2:**

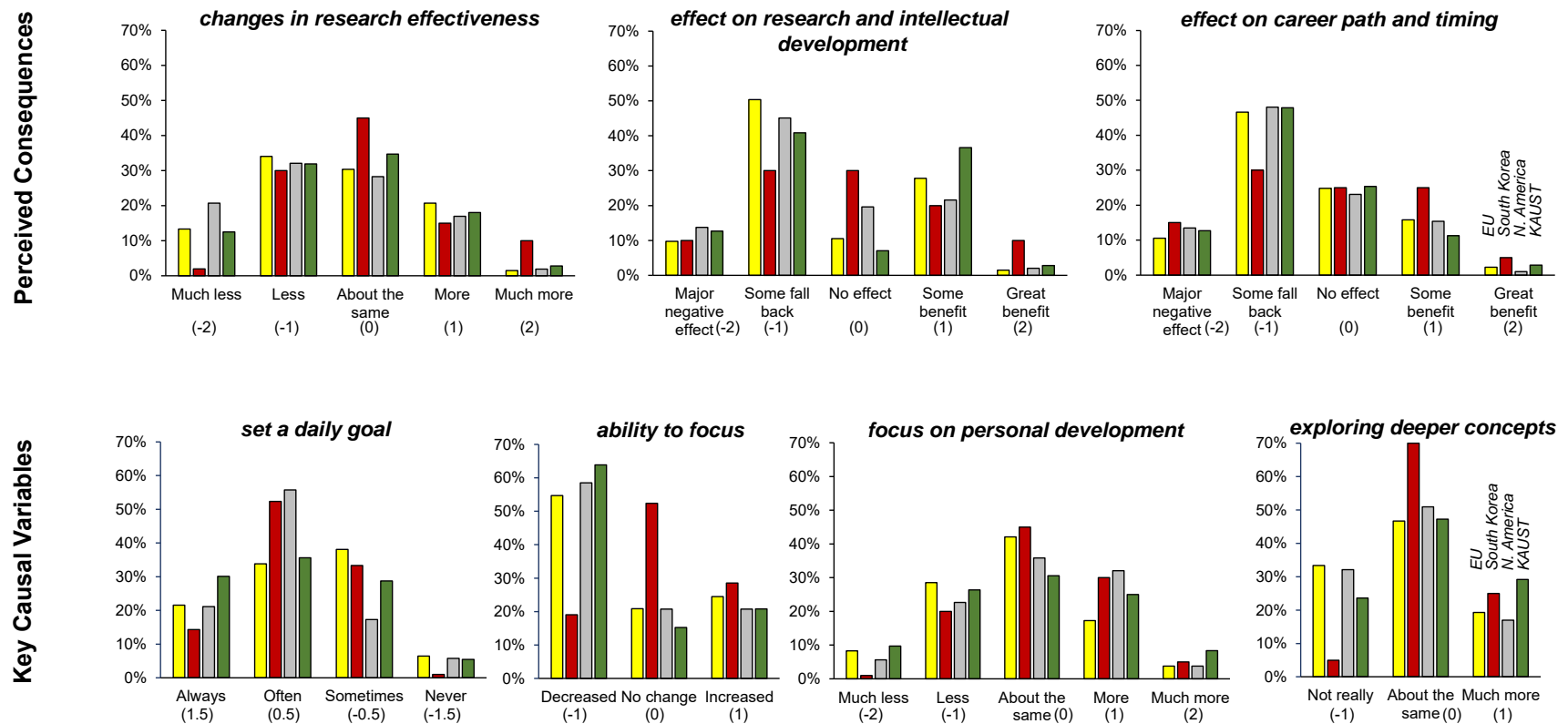
Age of survey respondents. The interpretation of the different age groups reflects common trends in the geo-science and engineering field. Color coding as noted in the figure: EU= yellow, South Korea= red, North America= gray, and KAUST= green.



75% are male  
25% live alone  
30% live with children

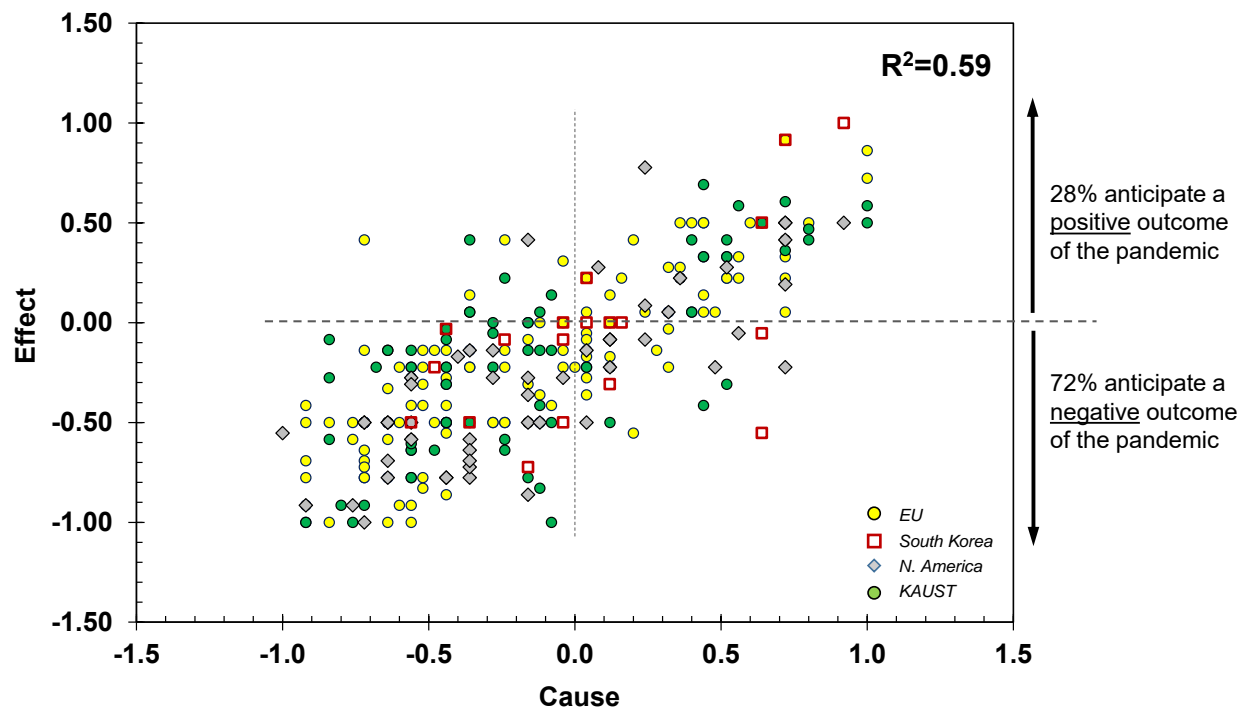
**Figure 3:**

Key variables emerging from the survey. Histograms in the top row show the perceived consequences of the coronavirus pandemic in terms of changes in research effectiveness, research and intellectual development, and career path and timing. The “**effect**” parameter combines an individual’s answers to these questions (Appendix 1: Questions 18, 19 and 20). Histograms in the bottom row summarize responses related to daily goals and focus; these form the “**cause**” parameter (Questions 6, 7, 13 and 17). Data analysis requires converting verbal responses and ratings to a numerical scale; assigned values are shown in parenthesis but were not visible to respondents.



**Figure 4:**

The effect of causal variables on the perceived positive or negative outcomes of the pandemic. Colors indicate geographical area. EU = yellow, South Korea = red, North America = gray and KAUST = green. Data analysis requires converting verbal responses and ratings to a numerical scale, shown in parentheses in Figure 3 (not visible to respondents).



**Figure 5:**

Lecture style preferences for content delivered (a) in person, (b) live online, e.g., via Zoom, and (c) through prerecorded online videos, e.g., Youtube. Most respondents are KAUST graduate students who suddenly transitioned from in-class to online education during mid-March 2020.

