



INTERNATIONAL JOURNAL FOR INNOVATION EDUCATION AND RESEARCH

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



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

Volume- 8 Number- 9

September 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: September 2019

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-8, ISSUE-9 of IJIER** which is scheduled to be published on **1st September 2020**.

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

Table of content

Paper ID	Title	Page
2204	Technological Forecasting of Traditional Knowledge Associated with Babassu <i>Authors: Junior Leal do Prado, André Luiz Gomes de Souza, Jose Maria Fernandez-Crehuet, Antônio Martins de Oliveira Júnior</i>	01-12
2261	Perspectives of Teacher Trainees' Preparedness and Adoption on Integration of ICT in Public Teacher Training Colleges in Kenya <i>Authors: Alice Omariba</i>	13-35
2377	Academic League of Urgency and Emergency Nursing as A Health Educational Tool: Experience Report <i>Authors: Henrique Cordeiro de Carvalho, OMAR PEREIRA DE ALMEIDA NETO, Suely Amorim de Araújo, Ricardo Gonçalves de Holanda</i>	36-46
2487	Pressure ulcers representation of life and death for wheelchair users <i>Authors: Bruna Henkel Ferro, Jacinta Sidegun Renner, Michele Barth, Eliane Fátima Manfio, Geraldine Alves dos Santos</i>	47-57
2586	Student Demographic Factors on Perception of The Influence of Guidance and Counselling and School Adjustment in Keiyo North Sub-County, Kenya. <i>Authors: Wilson Kiptala, John Kipruto, Evelyn Kanus</i>	58-74
2597	The Reasons for and Consequences of the Combined Use of Crack Cocaine and Alcohol in Brazil: qualitative study <i>Authors: Janaina Rubio Gonçalves, Solange Aparecida Nappo</i>	75-89
2599	Sustainability or Health: Why Brazilian Consumers Buy Organic Food? <i>Authors: Edmilson Pinto de Albuquerque, José Carlos Lázaro da Silva Filho, Josimar Souza Costa, Sandra Maria Santos</i>	90-107
2600	CNC Machine Building Through Open Sources Projects and Programs <i>Authors: André Amorim Gonçalves Xavier, Flavio Maldonado Bentes, Marcelo de Jesus Rodrigues da Nóbrega, Fabiano Battemarco da Silva Martins, Hildson Rodrigues de Queiroz</i>	108-118
2602	Identification of Variables and Information Requirements for Implementation of Traceability in Egg Production <i>Authors: Denise Belloni Ferrari Furlan, Mario Mollo Neto, Ricardo César Gonçalves Sant'ana, Leda Gobbo de Freitas Bueno, Marcelo Marques de Magalhães, Danilo Florentino Pereira</i>	119-130
2603	Professional Development in training and Tutoring Have I really gained experience and skill through training and tutoring sessions? Case of: a special third year student, language sciences and didactics (SLD), Department of English, University of Bejaia <i>Authors: Dr. Salima MAOUCHE-KETFI</i>	131-145
2604	Innovation in Manufacturing Industries and The Use of Industrial Property in Brazil <i>Authors: Rodrigo Rocha P Lima, Suzana Russo</i>	146-167
2609	Application of indexes to evaluate the water quality of the Continguiba/Pindoba Irrigated Perimeter in Sergipe, Brazil	168-185

	Authors: Amanda Oliveira Souza, Clayton Moura de Carvalho, Raimundo Rodrigues Gomes Filho, Carlos Alexandre Borges Garcia, Elder Sanzio Aguiar Cerqueira, Manoel Valnir Júnior, Leonaria Luna Silva de Carvalho, Renisson Neponuceno Araújo Filho, Victor Casimiro Piscoya, Moacyr Cunha Filho	
2611	Diagnostic aspects of juvenile ossificant fibroma: A case study Authors: João Paulo Martins de Oliveira, Maria Caroline Ferreira Cardoso, Ana Paula Silva Lopes, Aline Reis Stefanini, Paulo Henrique Bortoluzo, André Luís da Silva Fabris, Tais Cristina Nascimento Marques, Rogério Rodrigo Ramos, Nilton Cesar Pezati Boer, Luciana Estevam Simonato	186-196
2612	An Analog Circuit Course Teaching Method Based on the Analysis of Classic Application Circuits Authors: Qing Xiang	197-204
2615	Screening for antiviral activity of two purified saponin fractions of Quillaja spp. against Yellow Fever Virus and Chikungunya Virus Authors: Eduardo Artur Troian, Karoline Schallenberger, Francini Pereira da Silva, Gabriela Klein Dietrich, Fernando Ferreira Chiesa, Cristina Olivaro, Federico Wallace, Juliane Fleck, Simone Verza	205-214
2618	The Difference Between Environmental Costs in Mining Companies Before and After the Issuance of Indonesia Financial Accounting Standards (PPSAK) No. 12 of 2014 Concerning Soil Laying Activities and Environmental Management Authors: Sofyan Nur Hidayat, Lindrianasari Lindrianasari, Rindu Rika Gamayuni	215-223
2619	Motor Programs as Indicators of Penalty Direction in Soccer Authors: Luiz Felipe Pinto Oliveira da Motta, Ricardo Fontes Macedo, Elizabeth Cárprio Rivera, Angela Luciana De-Bortoli, Robelius De-Bortoli	224-233
2623	Education and sustainability in times of covid-19 pandemic Authors: Tayronne de Almeida Rodrigues, Estelita Lima Cândido, Francisca Laudeci Martins Souza	234-242
2625	An overview of the research and patenting activities that took place in Brazil during the 2010s Authors: Vinícius Eduardo Ferrari, Mrs. Maria Eduarda Carvalho de Araújo, Mr. Samuel Carvalho De Benedicto, Mr. Cândido Ferreira Silva Filho	243-253
2626	Promotion of the quality of life of workers in a higher education institution: a scope review Authors: Isaura Sousa, Márcia Teles, Tatyane Rodrigues, Fernando Lopes Silva-Júnior, Ana Maria Ribeiro, Fernanda Avelino	254-264
2628	Fatigue levels among Family Health Strategy professionals in the Brazilian countryside Authors: Fernanda Bernardeli Pereira, Núbia Fernandes Teixeira, Vanessa Cristina Bertussi, Samantha Pimenta Godoi, Kariciele Cristina Corrêa, Marcelle Aparecida de Barros Junqueira	265-279
2629	Risk Return Optimization Using the Knapsack Problem in The Formation of a Stocks Portfolio. Case Study of a Brazilian Investment Site. Authors: Nicolas Sampaio Bevilacqua, OCILEIDE Custodio da Silva, GABRIELA DE MATTOS VERONEZE	280-289

2631	The use of conflict mediation by the Sergipe River Basin Committee as a tool for implementing decentralised water resource management <i>Authors: Vanessa Gomes de Araújo, Gregorio Guirado Faccioli, Raimundo Rodrigues Gomes Filho, Anderson de Almeida Santos, Juan Mariano Camarillo Naranjo, Clayton Moura de Carvalho, Rodrigo Couto Santos</i>	290-303
2633	Course of Engineering Project Management for Automatic Engineering <i>Authors: Xu Wang, Xuewen Liu, Jiao Luo</i>	304-309
2635	Causes of Marital satisfaction and the criteria of choosing partners for marriage as Perceived by the People of Navrongo in The Upper East Region of Ghana <i>Authors: Joseph Akpadago</i>	310-320
2637	FAMILIES, GENERATIONS AND INTERGERACIONALITY IN NET MODERNITY <i>Authors: Camila Kuhn Vieira, Carine Nascimento da Silva, Ana Luisa Moser Keitel, Adriana da Silva Silveira, Solange Beatriz Billig Garces, Patrícia Dall'Agnol Bianchi, Marcelo Cacinotti Costa</i>	321-330
2638	The Relevance of Learning Brazilian Sign Language to The Socialization of Deaf People <i>Authors: Thelma Helena Costa Chahini, Ana Karina Verde Sampaio Mendes, Naysa Christine Serra Silva</i>	331-340
2640	Nutritional physical examination historical, methodological and applied approach <i>Authors: Luis Henrique Almeida Castro, Geanlucas Mendes Monteiro, Ygor Thiago Cerqueira de Paula, Vanessa de Souza Ferraz, Flavia Soares Bezerra Okumoto Nery de Mello, Dayane Aparecida Moisés Caetano Bottini, Nelson Thiago Andrade Ferreira, Tayla Borges Lino, Juliana Vicente de Souza, Gildiney Penaves de Alencar, João Vitor Alves dos Santos, Fernanda Viana de Carvalho Moreto</i>	341-346
2641	Anti-inflammatory foods human food patterns, bioactive principles and mechanisms of action <i>Authors: Luis Henrique Almeida Castro, Geanlucas Mendes Monteiro, Ygor Thiago Cerqueira de Paula, Vanessa de Souza Ferraz, Jessica Alves Ribeiro, Dayane Aparecida Moisés Caetano Bottini, Aline Ortega Soloaga, Nelson Thiago Andrade Ferreira, Tayla Borges Lino, Flavia Soares Bezerra Okumoto Nery de Mello, Juliana Vicente de Souza, Fernanda Viana de Carvalho Moreto</i>	347-353
2642	Endocannabinoid system conceptual parameters, history and therapeutic possibilities <i>Authors: Luis Henrique Almeida Castro, Geanlucas Mendes Monteiro, Ygor Thiago Cerqueira de Paula, Vanessa de Souza Ferraz, Flavia Soares Bezerra Okumoto Nery de Mello, Dayane Aparecida Moisés Caetano Bottini, Nelson Thiago Andrade Ferreira, Tayla Borges Lino, Juliana Vicente de Souza, Gildiney Penaves de Alencar, Wesley Sebastião da Silva Moraes, Fernanda Viana de Carvalho Moreto</i>	354-358
2643	Energy metabolism gluconeogenesis and oxidative phosphorylation <i>Authors: Luis Henrique Almeida Castro, Leandro Rachel Arguello, Nelson Thiago Andrade Ferreira, Geanlucas Mendes Monteiro, Jessica Alves Ribeiro, Juliana Vicente de Souza, Sarita Baltuilhe dos Santos, Fernanda Viana de Carvalho Moreto, Ygor Thiago Cerqueira de Paula, Vanessa de Souza Ferraz, Tayla Borges Lino, Thiago Teixeira Pereira</i>	359-368

2648	Family farming and sustainable rural development a case study in a settlement in the Brazilian Amazon <i>Authors: Carlos Alberto Paraguassu-Chaves, Osvaldo dos Anjos, Allan Kardec Duailibe Barros Filho, Fulvia Vera de Martinez, Fabrício Moraes de Almeida, João Viana Fonseca Neto, Charlles da Silva Barata, Lenita Rodrigues Moreira Dantas, Fabio Robson Casara Cavalcante</i>	369-394
2650	A Mobile application proposal for mapping of multi-drug resistant bacteria information management: A study applied in a Brazilian city <i>Authors: Marcio Rodrigo Santos, Lucas José de Souza, Egon Walter Wildauer, Suelen Balero de Paula-Petroli, Floristher Elaine Carrara-Marroni</i>	395-403
2653	Aspects Related to Nurse Leadership in Several Places of Action: Literature Review <i>Authors: Antonny Michael da Silva Sousa, Mikaelly Pinheiro Garcia, Eveline Menezes Caçote Barbosa, Loren Rebeca Anselmo do Nascimento, Rayner Augusto Libório dos Santos Monteiro, Graciana de Sousa Lopes</i>	404-415
2657	Application of the Kalman Filter in Functional Magnetic Resonance Image Data <i>Authors: Valcir J. da C. Farias, Marcus P. C. Rocha, Heliton Tavares</i>	416-433
2659	Review of Clinical Factors That Cause Acne Vulgaris <i>Authors: Zípora Santos, Maiara Velho, Fátima Zan, Virgínia Rech, Aline Ferreira Ourique</i>	434-447
2662	Youths and their future perspectives: a systematization of experiences <i>Authors: LUIS EURICO KERBER, Ms. Tatiane de Oliveira, Dra. Dinora Tereza Zucchetti</i>	448-462

Technological Forecasting of Traditional Knowledge Associated with Babassu

Junior Leal do Prado (Corresponding author)

Dept. of Mathematics, Federal Institute of Sergipe,
Aracaju/SE, Brazil.
jrprado@gmail.com

André Luiz Gomes de Souza

Federal University of Sergipe,
São Cristóvão/SE, Brazil.
andre.luizgomes@yahoo.com.br

Jose Maria Fernandez-Crehuet

Dept. of Organization Engineering, Business Administration and Statistics, Polytechnic University
of Madrid, Madrid, Spain.
josemaria.fernandez-crehuet@upm.es

Antônio Martins de Oliveira Júnior

Dept. of Food Technology, Federal University of Sergipe,
São Cristóvão/SE, Brazil.
amartins.junior@gmail.com

Abstract

Babassu is a native palm tree from Brazil traditionally used by Indigenous Peoples (IP) and Traditional Communities (TC), in order to produce medicines applied in different treatments. Some of these medicinal applications have been scientifically analyzed in order to prove their pharmacological potentialities and have also been an object of interest for the protection of Intellectual Property Rights. The objective of this work was to carry out the technological forecasting of traditional knowledge associated with babassu related to the treatments applied by traditional medicine and to analyze the indicators connected with to the protection of Intellectual Property Rights. Initially, we conducted a survey of ethnobotanical and ethnopharmacological studies, presenting applications of babassu performed by traditional medicine. Subsequently, we presented a literature review, focused on analyzing the effects of babassu according to the practices of traditional medicine. Finally, we analyzed the records of filed patents made in World Intellectual Property Organization (WIPO), European Patent Office (EPO) and Latin American Base of the European Patent Office (LATIPAT) in relation to previously identified Traditional Knowledge Associated (TKA). There were different types of babassu applications used by traditional medicine, according to the results of the ethnobotanical and ethnopharmacological studies carried out in Brazil. The applications that stood out were related to anti-inflammatory and cicatrizant treatments. Most of the pharmacological

research that focused on proving the medicinal potential associated with the use of babassu, analyzed applications in anti-inflammatory and cicatrizant treatments, which mostly demonstrated these potentialities. It was verified that the interests for the protection of Intellectual Property Rights of the TKA with babassu, and the anti-inflammatory and cicatrizant treatments, presented a growth. This study contributes with positive evidence for the medicinal and cosmetic potentialities of babassu presented by traditional medicine. However, it also shows that holders of TKA have not been involved in the processes of protection of Intellectual Property Rights of inventions that apply TKA with babassu. In view of the related conflicts, it is suggested that TKA be valued in management and conservation practices.

Keywords: *babassu; orbignya phalerata; orbignya oleifera; attalea speciosa; attalea phalerata; Intellectual Property Rights; filed patents.*

1. Introduction

The term Traditional Knowledge Associated (TKA) refers to traditional knowledge that is related to the use of genetic resources of biodiversity, characterized by the production of intellectual activity (CHOUHAN, 2012). The TKA is observed in Indigenous Peoples (IP) and Traditional Communities (TC)'s knowledge and tasks in different contexts, such as agricultural, food, medicinal and technological (SOUZA *et al*, 2015). In literature, several studies are interested in identifying IP and TC's TKA (LIU *et al*, 2016; IJAZ *et al*, 2016; BRADAIA *et al*, 2015; SILVA *et al*, 2006), while other branches of the research are focused on scientifically proving the potentialities presented by TKA (MIRANDA *et al*, 2006; SILVA *et al*, 2006; BRITO FILHO *et al*, 2006; ASSUMPÇÃO *et al*, 2014; GUILLON *et al*, 2011).

Among many species of Brazilian biodiversity that present alimentary, medicinal and technological potentialities, one of the most remarkable is Babassu (*Orbignya speciosa*) (CARRAZA *et al*, 2012; BALICK and PINHEIRO, 2000).

According to IP and TC in Brazil, babassu has different pharmacological applications. Ethnobotanical and ethnopharmacological studies have shown benefits associated with the use of babassu in cutaneous cicatrizant processes (RUFINO, 2008; SILVA, 2013), in anti-inflammatory processes (BRAGA, 1960; MATOS, 1989) and in the treatment of kidney disorders (POVH *et al*, 2014). Some of these applications of traditional medicine have been scientifically confirmed (MAIA, 1987; CAETANO *et al*, 2002; BRITO FILHO *et al*, 2006; MARTINS *et al*, 2015).

In view of this reality, it is considered that the TKA with babassu has a great scientific and technological value and the realization of Technological Forecasting (TF) makes it possible to verify the technological advances related to the applications of TKA with babassu.

TF is a systematic way of mapping scientific and technological development that can significantly influence industry, economy or society in general (KUPFER and TIGRE, 2004). According to Souza *et al* (2015), TF presents itself as a strategy that allows the identification of emerging opportunities, trends and priorities, which are considered of high relevance for the promotion of technological innovation and sustainability. Important technological information is found in the patent bases, which present numerous information in connection with the applications submitted and the granted patents. It is possible to find, for example:

publication number, application number, title of the invention, inventor's name, name of the field, international patent classification, abstract, a detailed description of the invention and claims (MONTECCHI *et al*, 2013).

In view of the above context, the objective of this work was to carry out the Technological Forecasting of Traditional Knowledge Associated (TFTKA) with babassu connected with ethnopharmacological treatments and analyze the indicators related to the protection of Intellectual Property Rights.

2. Methodology

We conduct the descriptive research to carry out the Technological Forecasting of Traditional Knowledge Associated with Babassu. We handled official documents and scientific bibliography. The identified data was qualitatively and quantitatively analyzed.

We identified TKA with babassu in relation to traditional medicinal treatments and their respective scientific evidence based on the information presented by books, dissertations, theses and scientific articles presented in the bases Science Direct, Elsevier and Scielo. Regarding TFTKA with babassu, we identified information linked to traditional medicinal treatments based on the material found in the following patent bases: European Patent Office (EPO), Latin American Base of the European Patent Office (LATIPAT) and World Intellectual Property Organization (WIPO). The following keywords were used in the scopes of the research in order to identify TKA and the scientific evidence related to TKA and TFTKA: “babaçu”, babassu, *orbignya*, *orbignya phalerata*, *orbignya oleifera*, *attalea*, *attalea phalerata*, and *attalea speciosa*. In order to identify TFTKA with babassu, we selected the sub-classification A61 of the International Patent Classification (IPC), which is related to the patents of medical products, hygiene and cosmetics, in order to detect patents in the field of medicine and pharmacology areas. The TFTKA was held in July 2016 and the previously indicated keywords were applied in the "Title" and “Abstract” fields during the search in the patent bases.

All patent filed records published until June 2016 were individually analyzed by discarding duplicated documents. The following fields were analyzed: patent application number; title; abstract; inventors; applicants; year of filed; country of filed; International Patent Classification (IPC); and product and/or process. Subsequently, the incidence of TKA applications to babassu was analyzed in all the filed patents considered in this research.

3. Results and Discussion

The results of the ethnobotanical and ethnopharmacological research were a total of eight different applications of babassu carried out by traditional medicine. The treatments that stood out quantitatively were the cicatrizant treatments (50%) and anti-inflammatory treatments (37.5%) (Table 1). At least two medicinal applications of babassu were presented in six different studies.

Table 1. TKA with babassu applied by traditional medicine.

Treatment	Plant Part	Authors	Publication Type	Country
Anti-inflammatory	N.S.*	Braga (1960)	Book	Brazil
Anti-inflammatory and cicatrizant	Mesocarp	Pires (1974)	Book	Brazil
Vermifuge and anti-influenza	Oil	Balick (1984)	Scientific Article	Brazil
Anti-inflammatory	N.S.*	Matos (1989)	Book	Brazil
Laxative and treatment of amenorrhea	N.S.*	Martins (2001)	Book	Brazil
N.S.*	N.S.*	Pinheiro <i>et al</i> (2005)	Scientific Article	Brazil
Cicatrizant and antiseptic	Oil	Azevedo (2007)	Thesis	Brazil
Analgesic, cicatrizant and laxative	Almond and oil	Rufino (2008)	Scientific Article	Brazil
Cicatrizant	Leaf and fruit	Silva (2013)	Thesis	Brazil
Kidney treatment	N.S.*	Povh <i>et al</i> (2014)	Scientific Article	Brazil
Antiseptic and cosmetic	Almond and oil	Arruda (2014)	Scientific Article	Brazil
Antiseptic	Stem, leaf, mesocarp and almond	Arruda (2013)	Thesis	Brazil

Source: Prepared by the authors. / N.S*: Not specified.

In the present study, it was verified that 92.30% of the scientific research identified in the literature review, in Section 2, addressed the TKA with babassu, and, mostly confirmed the efficacy of the treatments (Table 2).

It was also verified that all the scientific research identified in Section 2, applied the mesocarp of the fruit for the accomplishment of the experiments (Table 2). The only exception observed in present research was in relation to the analgesic treatment, which had not been identified in any of the results of the ethnobotanical or ethnopharmacological surveys that were analyzed.

Table 2. Results of the review of identification of scientific researches that prove the efficacies of TKA with babassu applied by traditional medicine in Brazil.

Treatment	Plant Part	Authors	Publication Type
Anti-inflammatory	Mesocarp	Maia (1987)	Thesis
Cicatrizant	Mesocarp	Barroqueiro <i>et al</i> (2001)	Scientific Article
Anti-inflammatory and Immunomodulator	Mesocarp	Silva (2001)	Scientific Article
Immunomodulator	Mesocarp	Barroqueiro (2001)	Scientific Article
Antimicrobial	Mesocarp	Caetano <i>et al</i> (2002)	Scientific Article
Anti-inflammatory and cicatrizant	Mesocarp	Moura (2002)	Scientific Article
Gastric and duodenal ulcers	Mesocarp	Carvalho (2003)	Scientific Article
Cicatrizant	Mesocarp	Amorim <i>et al</i> (2006)	Scientific Article
Anti-inflammatory and analgesic	Mesocarp	Baldez (2006)	Scientific Article
Cicatrizant	Mesocarp	Brito Filho <i>et al</i> (2006)	Scientific Article
Cicatrizant	Mesocarp	Martins (2006)	Scientific Article
Cicatrizant	Mesocarp	Ferreira (2006)	Scientific Article
Cicatrizant	Mesocarp	Silva <i>et al</i> (2015)	Scientific Article

Source: Prepared by the authors.

The results of TFKKA presented filed patents linked to technological applications of babassu in all bases analyzed. In general, filed patents connected with alimentary, medical, cosmetical, chemical, pharmaceutical or biotechnological products were verified. A total of 50 filed patents were found in the EPO, LATIPAT and WIPO databases, which occurred within the period from 1953 to 2016. The quantitative results of TFKKA defined in the methodology of this research are presented in Table 3.

Table 3. Total patent filed records.

Keywords	EPO	LATIPAT	WIPO	Total
“Babaçu”	0	7	0	7
<i>Babassu</i>	33	1	1	35
<i>Orbignya</i>	3	5	0	8
<i>Orbignya phalerata</i>	0	0	0	0
<i>Orbignya oleifera</i>	0	0	0	0
<i>Attalea</i>	0	0	0	0
<i>Attalea phalerata</i>	0	0	0	0
<i>Attalea speciosa</i>	0	0	0	0
Total	36	13	1	50

Source: Prepared by the authors.

Since 1953, according to the filed patent for an injectable pharmaceutical composition containing trypsin,

babassu by-products have been considered to be of commercial interest and protection of Intellectual Property Rights.

In view of all the data of this research, we confirmed that companies show a great interest in patenting products and processes related to babassu, which is a 60% of the total number of the filed patents. The patent applications from natural persons constitute the 22% of the total number of the filed patents, while the Scientific, Technological and Innovation Institutions (STIs) represent just the 16% of the total number and, finally, the 2% corresponds to the third sector (Figure 1).

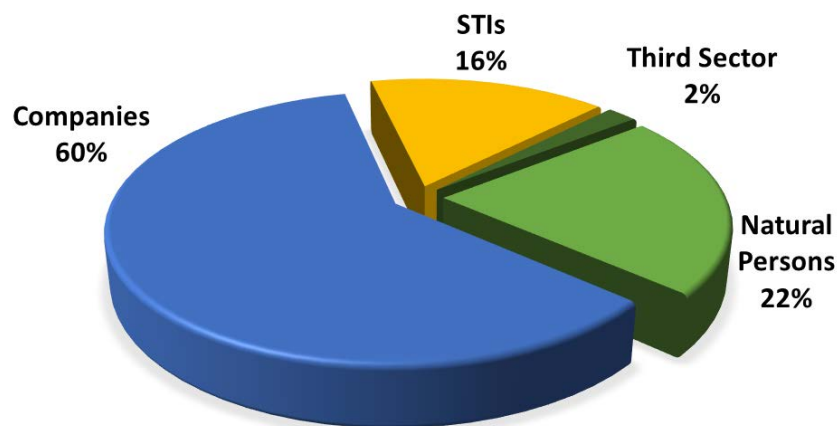


Figure 1. Relation between “Number of Filed Patents” and “Applicants Category”.

Source: Prepared by the authors.

Figure 2 shows the time series of filed patent applications for products and/or processes related to babassu per decade, found in patent databases. The data demonstrates a recent interest in patenting products and/or processes in relation to babassu, since the largest number of filed patents has occurred in the present decade.

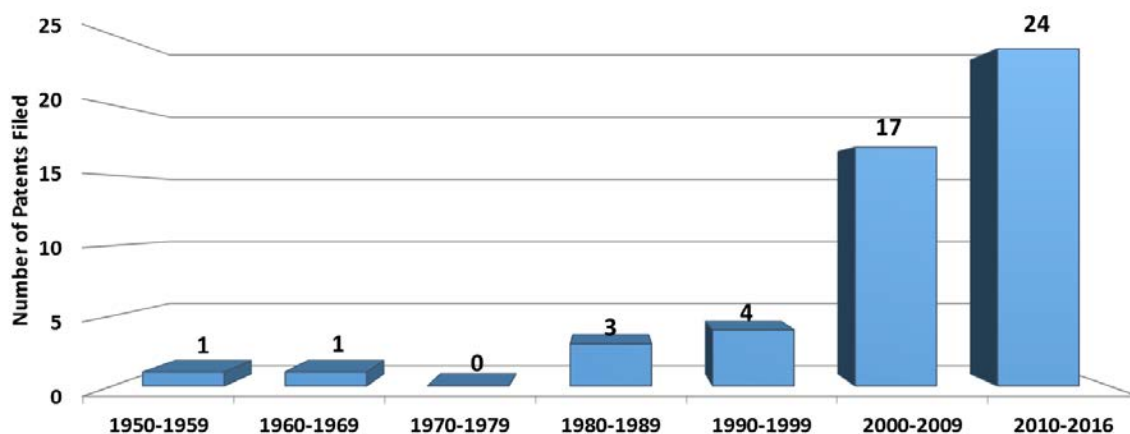


Figure 2. Evolution of the number of filed patents per decade from 1950 to 2016.

Source: Prepared by the authors.

It is worth noting that not all filed patents have been published due to the confidentiality period. There are still filed patents pending to be published corresponding to the last three years of the present decade. However, there is already a high number of filed patents linked to babassu, which shows that products

and/or process involving babassu are still an important market niche to be explored by companies with regard to the research and development of new technologies or products. This finding, obtained by means of the technological survey conducted, corroborates the results observed in the ethnobotanical and ethnopharmacological review presented in this paper.

Regarding the origin of the filed patents (Figure 3), the main applicants are Brazil and China, which lead the ranking with a total of 13 filed patents by each country, followed by the USA with 08 filed patents. It has been found that a large part of the filed patents made by Brazil and China is connected with pharmacological and cosmetic products and processes.

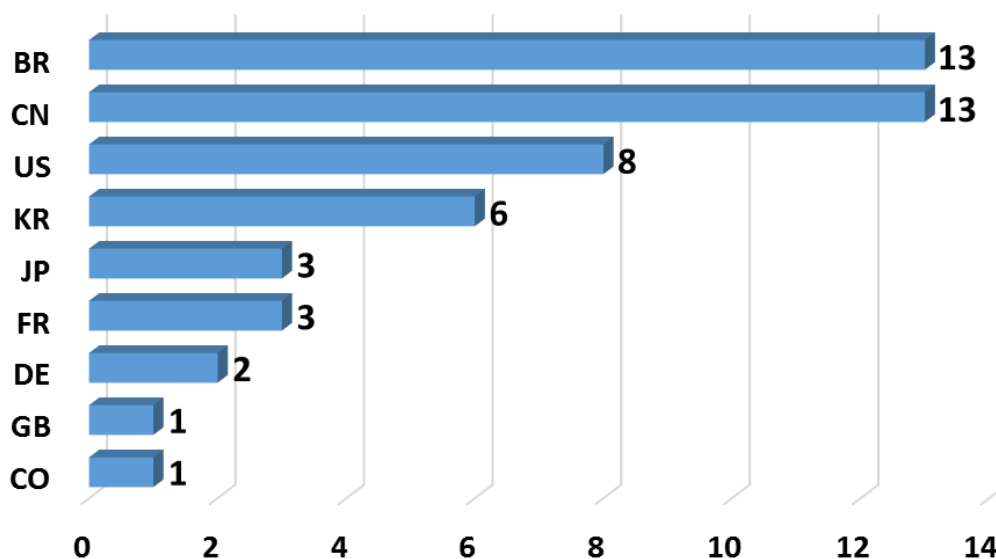


Figure 3. Distribution of the number of filed patents in relation to the countries of origin of the filed.

Subtitle: BR: Brazil; CN: China; CO: Colombia; DE: Germany; FR: France; GB: United Kingdom; JP: Japan; KR: South Korea; US: United States of America.

Source: Prepared by the authors.

In the 50 filed patents analyzed in this research with respect to IPC classifications, the four subclasses that stand out quantitatively (Figure 4) are: A61K (Preparations for Medical, Dental, or Toilet Purposes); A61Q (Specific use of Cosmetics or Similar Toilet Preparations); A61P (Specific Therapeutic Activity of Chemical Compounds or Medicinal Preparations); C11D (Detergent Compositions; Use of Single Substances as Detergents; Soap or Soap-Making; Resin Soaps; Recovery of Glycerol).

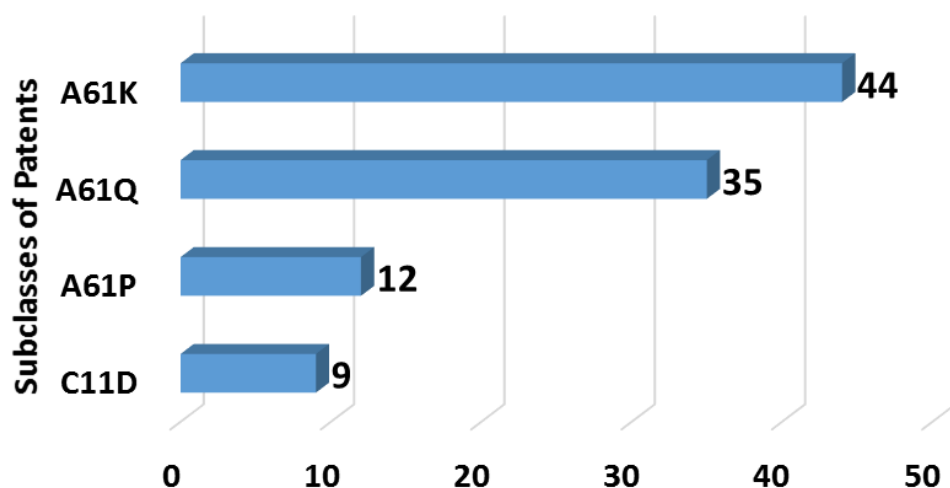


Figure 4. The most frequent IPC subclasses of filed patents.

Source: Prepared by the authors.

The medicinal treatments based on TKA with babassu that have been stood out as main objectives for the protection of Intellectual Property Rights, are linked to the application of by-products in cicatrizant (LATIPAT, EPO and WIPO) and anti-inflammatory (EPO and WIPO) treatments. Product records in relation to antimicrobial, antiseptic and antidiarrheal effects were also identified in the WIPO database.

In addition to the applications of traditional medicine identified in this study, other patenting processes related to applications of babassu for the treatment of neoplasms (LATIPAT and WIPO), the regulation of immunomodulatory activity (LATIPAT) and the moisturizing effect (LATIPAT).

The importance that biodiversity has assumed as a source of raw material and new solutions for the pharmaceutical industry has been growing constantly during the last decades (ALIER, 2012). According to Calixto (2003), about 40% of the medicines available in 2003 were developed from natural resources. Subsequently, according to Saccaro Júnior (2011), this percentage reached 50% in 2011 and, in the case of anticancer drugs and antibiotics, the percentage reached up to 70%.

As genetic resources for biodiversity, TKA has also been consolidated as an important source of information applied by research centers and pharmaceutical and biotechnological industries in drug development (ALIER, 2012). According to Santilli (2005), TKA has a particular importance for the biotechnological, pharmaceutical, chemical and agricultural industries because they present useful information to identify active principles of biomolecules or functional characteristics of cells and microorganisms, regardless of whether the traditional application coincides or not with industrial application.

However, the relations between IP and TC holding the TKA and those that access and commercialize technological products developed with information from TKA have presented different types of conflicts related to the recognition of the origin of the TKA, with the benefit distributions arising from the commercial activities, with the misappropriation of the Intellectual Property Rights and the preservation and sustainable use of genetic resources (ALIER, 2012).

In this sense, it is considered that the commercial exploitation of babassu genetic resources and its respective TKA should be accompanied by actions that contribute to the three main pillars of the 1992

Biodiversity Convention: biodiversity conservation, sustainable use of natural resources and fair and equitable allocation of benefits arisen from commercial applications with IP and TC that hold the TKA.

According to Pereira and Diegues (2010), the current global environmental scenario, which has been a cause of concern for different segments of society, has led to the emergence of new concepts that have been adopted with the aim of achieving effective protection of natural resources. Therefore, IP and TC and their respective knowledge came to be covered by the ethnoconservation perspective, which associates the conservation of nature with the valuation of TKA.

Thereby, in order to achieve a level of rational, sustainable, fair and equitable exploitation of local genetic resources and TKA, it is considered necessary to anticipate actions that contribute to the preservation of the local, social and cultural contexts in which they transmit and innovate the TKA. Also, it is essential to predict actions that contribute to the preservation and diffusion of traditional practices for a sustainable management of natural resources, as well as preservation, diffusion and management actions of TKA related to medicinal, biotechnological and alimentary potentialities.

5. Conclusion

The findings of the ethnobotanical, ethnopharmacological and pharmacological review carried out in this paper, as well as TFKTA with babassu, contribute with positive evidence for medicinal and cosmetic potentialities associated with babassu that are identified in the popular orality of IP and TC in Brazil.

It can be confirmed that TKA with babassu and the actions that relate the medicinal applications of babassu identified in the review conducted in the present study, have been object of interest of the protection of Intellectual Property Rights in different countries.

It has also been found that none of the processes of the protection of Intellectual Property Rights of inventions making use of TKA with babassu, presented by Patent Offices, mention the IP and TC participation in any stage of technological development, and not even in Applicants or Inventors conditions.

6. References

- Alier, J. M., 2012. El ecologismo de los pobres: conflictos ambientales y lenguajes de valoración. 2° ed. Contexto, São Paulo.
- Amorim, E., Matias, J.E.F., Coelho, J.C.U., Campos, A.C.L., Stahlke Júnior, H.J., Timi, J.R.R., Rocha, L.C.A., Moreira, A.T.R., Rispoli, D.Z., Ferreira, L.M., 2006. Topic use of aqueous extract of *Orbignya phalerata* (babassu) in rats: analysis of it's healing effect. Acta cir. bras. 21(supl.2), 67-76.
- Arruda, J.C., Silva, C.J., Sander, N.L., 2014. Conhecimento e uso do babaçu (*Attalea Speciosa* Mart.) por Quilombolas em Mato Grosso. Frag. de Cultura. 24, 239-252.
- Assumpção, C.F., Bachiega, P., Morzelle, M.C., Nelson, D.L., Ndiaye, E.A., Rios, A.O., Souza, E.C., 2014. Characterization, antioxidant potential and cytotoxic study of mangaba fruits. Ciência Rural. 44, 1297-1303.

Balick, M.J., Pinheiro, C., 2000. Babaçu *Orbignya phalerata*. in: Clay, J., Sampaio, P., Clement, C., (Eds.) Biodiversidade Amazônica: Exemplos e Estratégias de Utilização. Óleos Industriais. E-Publishing Inc., Manaus, pp. 255-263.

Batista, C.P., Torres, O.J.M., Matias, J.E.F., Moreira, A.T.R., Colman, D., Lima, J.H.F., Macri, M.M., Rauen Junior, R.J., Ferreira, L.M., Freitas, A.C.T., 2006. Effect of watery extract of *Orbignya phalerata* (babassu) in the gastric healing in rats: morfologic and tensiometric study. Acta Cir. Bras. 21, 26-32.

Bradai, L., Neffar, S., Amrani, K., Bissati, S., Chenchouni, H., 2015. Ethnomycological survey of traditional usage and indigenous knowledge on desert truffles among the native Sahara Desert people of Algeria. J. Ethnopharmacol. 162, 31–38.

Braga, R., 1960. Plantas do Nordeste: Especialmente do Ceará, fourth ed. UFRN, Fortaleza.

Brito Filho, S.B., Matias, J.E.F., Stahlke Júnior, H.j., Torres, O.J.M., Timi, J.R.R., Tenório, S.B., Tâmbara, E.M., Carstens, A.G., Campos, R.V., Myamoto, M., 2006. Analysis of healing in the alba linea with the use of *Orbignya Phalerata* (babassu) water extract. controlled study in rats. Acta cir. bras. 21, 76-89.

Bruschi, P., Morganti, M., Mancini, M., Signorini, M.A., 2011. Traditional healers and laypeople: A qualitative and quantitative approach to local knowledge on medicinal plants in Muda (Mozambique). J. Ethnopharmacol. 138, 543–563.

Caetano, N., Saraiva, A., Pereira, R., Carvalho, D., Pimentel, M.C.B., Maia, M.B.S., 2002. Determinação de atividade antimicrobiana de extratos de plantas de uso popular como anti-inflamatório. Rev. Bras. Farmacogn. 12, 132-135.

Calixto, J. B., 2003. Biodiversidade como fonte de medicamentos. Cienc. Cult., São Paulo, 55, 37-39.

Carrazza, L.R., Silva, M.L., Ávila, J.C.C., 2012. Manual tecnológico de aproveitamento integral do fruto do babaçu. Instituto Sociedade, População E Natureza, Brasília.

Chouhan. V. K., 2012. Protection of Traditional Knowledge in India by Patent: Legal Aspect. IORS Journal of Humanities and Social Science (JHSS). 3, 35-42.

Ferreira, E.C., Matias, J.E.F., Campos, A.C.L., Tâmbara Filho, R., Rocha, L.C.A., Timi, J.R.R., Sado, H.N., Sakamoto, D.G., Tolazzi, A.R.D., Soares Filho, M.P., 2006. Surgical blader wounds treated with *Orbignya Phalerata* aqueous extract: controlled study in rats. Acta cir. bras. 21, 33-40.

Guilhon, C.C., Raymundo, L.J.R.P., Alviano, D.S., Blank, A.F., Arrigoni-blank, M.F., Matheus, M.E.,

Cavalcanti, S.C.H., Alviano, C.S., Fernandes, P.D., 2011. Characterisation of the anti-inflammatory and antinociceptive activities and the mechanism of the action of *Lippia gracilis* essential oil. J. Ethnopharmacol. 135, 406–413.

Ijaz F., Iqbal Z., Rahman I.U., Alam J., Khan S.M., Shah G.M., Khan K., Afzal A., 2016. Investigation of traditional medicinal floral knowledge of Sarban Hills, Abbottabad, KP, Pakistan. J. Ethnopharmacol. 179, 208–233.

Kupfer, D.; Tigre, P.B., 2004. Prospecção tecnológica. In: Caruso, L.A.C., Tigre, P.B. (Eds.), Modelo SENAI de prospecção: documento metodológico. E-Publishing Inc., Montevideo, pp. 17-29.

Liu, B., Guo, Z., Bussmann, R., Li, F., Li, J., Hong, L., Long, C., 2016. Ethnobotanical approaches of traditional medicine studies in Southwest China: a literature review. J. Ethnopharmacol. 186, 343–350.

Maia, M. B., 1987. Estudo de atividade anti-inflamatória e outros efeitos farmacológicos relacionados a *Orbignia phalerata* Mar. Departamento de Fisiologia. UFC, Fortaleza. (Thesis)

Martins, N.P.L., Malafaia, O., Ribas Filho, J.M., Heibel, M., Baldez, R.N., Vasconcelos, P.R.L., 2006. Healing process in cutaneous surgical wounds in rats under the influence of *Orbignya phalerata* aqueous extract. Acta cir. bras. 21(3), 66-75.

Matos, F.J.A., 1989. Farmácias vivas. UFC, Fortaleza.

Miranda, C.A.S.F., Cardoso, M.G., Batista, L.R., Rodrigues, L.M.A., Figueiredo, A.C.S., 2016. Essential oils from leaves of various species: antioxidant and antibacterial properties on growth in pathogenic species. Ciência Agronômica. 47, 213-220.

Montecchi, T.; Russo, D.; Liu, Y., 2013. Searching in Cooperative Patent Classification: Comparison between keyword and concept-based search. Adv. Eng. Inf., 27, 335-345.

Pereira, B. E.; Diegues, A. C., 2010. Indigenous Knowledge as a possibility of nature conservation: a reflection on the perspective of Ethno Conservation. Desen. Meio Amb. 22, 37-50.

Pinheiro, C.U.B.; Santos, V.M. & Ferreira F.R.R., 2005. Usos de subsistência de espécies vegetais na região da baixada maranhense. Amazônia: Ciência & Desenvolvimento. 1, 235-250.

Povh, J.A., Assunção, E.F., Rocha, L.M., Ferreira, G.L.S., 2014. Estudo Etnobotânico de plantas medicinais utilizadas pela população da comunidade Boa Vista, Prata – MG. Braz. Geographical Journal: Geosciences and Humanities research medium. 5, 46-59.

Rufino, M.U.L., Costa, J.T.M., Silva, V.A., Andrade, L.H.C., 2008. Conhecimento e uso do ouricuri (*Syagrus coronata*) e do babaçu (*Orbignya phalerata*) em Buíque, PE, Brasil. *Acta bot. bras.* 22, 1141-1149.

Saccaro Junior, N. L., 2011. A regulamentação de acesso a recursos genéticos e repartição de benefícios: disputas dentro e fora do Brasil. *Ambient. soc.* 14,229.244.

Santilli, J., 2005. Socioambientalismo e Novos Direitos: Proteção jurídica à diversidade biológica e cultural. Ed. Peirópolis, São Paulo.

Silva, C.E.S., Santos, O.J., Ribas-filho, J.M., Tabushi, F.I., Kume, M.H., Jukonis, L.B., Cella, I.F., 2015. Effect of *Carapa guianensis* Aublet (*Andiroba*) and *Orbignya phalerata* (Babassu) in colonic healing in rats. *Rev. Col. Bras. Cir.* 42, 399-406.

Silva, N. F., 2013. Contribuição do saber local na identificação de plantas medicinais prioritárias para a conservação in situ na Floresta Nacional do Araripe, Nordeste do Brasil. Programa de Pós-graduação em Botânica, UFRPE, Recife, 84, (Thesis).

Silva, T.S., Freire, E.M.X., 2010. Abordagem etnobotânica sobre plantas medicinais citadas por populações do entorno de uma unidade de conservação da caatinga do Rio Grande do Norte, Brasil. *Rev. Bras. Pl. Med.* 12, 427-435.

Souza, A.L.G., Prado, J.L., Oliveira Júnior, A.M., Silva, G.F., 2015. Associated Traditional Knowledge and Technological Prospection of *Hancornia speciosa* Gomes. *GEINTEC.* 5, 2652-2663.

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/>).

Perspectives of Student Teacher Trainees' Preparedness and Adoption on Integration of ICT in Public Teacher Training Colleges in Kenya

Alice Omariba

School of Education

Murang'a University of Technology, Kenya.

Abstract

This study was concerned with perspectives of student teacher trainees' preparedness and adoption on integration of ICTs in public teacher training colleges. Effective preparedness and adoption on integration of ICTs contributes greatly to the quality of education delivered in an instructional process. The rationale was conceptualized from the TPACK model that ICT use in the classroom is important for giving students opportunities to learn and apply the required 21st century skill, improves teaching and learning and important for teachers in performing their role as designers of pedagogical environments. The curriculum needs academic standards and the development of digital age skills for the 21st century learners to fit in the global job market. The literature review focused on the global overview on integration of ICT in education, status of integration of ICT in education in Africa, readiness in the integration of ICT in education in Kenya and challenges of integrating ICTs in the primary teacher curriculum. A descriptive survey research design was used in the study which was conducted in four (4) public primary teacher training colleges in Central region of Kenya. These provided an ideal population for the study. The target populations were second year student teacher trainees, College principals and Kenya Institute of Curriculum Development (KICD) e-learning Officers. The major research instruments were questionnaires for student teacher trainees, interview schedule for the principals and Kenya Institute of Curriculum Development e-learning developers, and observation schedule. The obtained data were analyzed systematically using descriptive statistics and presented with the help of frequency tables, figures and percentages. Findings of the study revealed that preparedness on integration of ICTs was at an infant stage. The study also revealed that the training was only offering pedagogy, content, knowledge but not the technology which make integration a reality in the classroom setting. There were inadequate infrastructure to enhance integration and student teacher trainees revealed lack policy that would help adoption on integration of ICTs in teaching learning process.

Key Words: Preparedness, Adoption, Integration, Information Communication Technology, Pre-service training institution

1. Introduction

ICT stands for "Information and communication technology". It refers to technologies that provide access to information through telecommunication. It is similar to Information Technology (IT) but focuses

primarily on communication technologies. This includes the internet, wireless networks, cell phones and other communication mediums. It means more opportunities to use ICT in teacher training programmes to improve quality of teachers for teach effectively. According to UNESCO “ICT is a scientific, technological and engineering discipline and management technique used in handling information, its application and association with social, economic and cultural matters”. Teaching is the main part of the educational field in the society. Teachers work more for the improvement level of our society in the every field and skilled teachers can make the creative students in form of the good social worker, politician, poet, philosopher etc. for the society. Teachers can play a friendly role with the learner. The rapid development in technology has made innovative changes in the way people live, as well as digital societies. Recognizing the impact of technologies in the workplace and everyday life, today’s teacher education institutions try to streamline their education programs and classroom facilities in order to minimize the teaching and learning technology gap between today and the future (Ratheeswari, 2018). This study was concerned with perspectives of student teacher trainees’ preparedness and adoption on integration of ICTs in public teacher training colleges. Effective preparedness and adoption on integration of ICTs contributes greatly to the quality of education delivered in an instructional process. The curriculum needs academic standards and the development of digital age skills for the 21st century learners to fit in the global job market.

1.1. Background to the Study

The development of skills and knowledge in the use of ICTs is increasingly deemed to be an important aspect of preparation for participation in an information society, as integration of ICTs enhances the quality of learning and teaching in classrooms. As a result, teachers and instructors need to be trained in basic ICT skills and ICT-based teaching methods to feel comfortable about integration (International Institute for Communication and Development, 2007). Despite significant political will and expenditure on equipment and training, levels of ICT integration in classrooms for teaching and learning are often low Taylor (2004). Further research shows that despite all these investments on ICT infrastructure, equipment and professional development to improve education in many countries, less developed world face more serious problems such as massive growth in enrolment and institutional development, bad governance, high costs, poor and uneven distribution of ICTs and infrastructure, incorrectly viewing ICTs as a problem for organizational transformation, not making ICT responsive to the organizational vision and mission, and developing a non-systemic method of implementing ICTs (Mbodila, Jones and Muhandji, 2013). Gulbahar (2007) claimed that huge educational investment has produced little evidence of ICT adoption and use in teaching and learning. Student teacher trainees should be prepared to integrate information and communication technologies (ICTs) into their future teaching and learning practices. iiCD (2007) observe that:

‘...education enhanced by ICTs, not only sparks economic development by improving learners’ skills, but it also enhances social development across the community by raising peoples’ awareness of their ability to improve their health, their environment, and even the way they are governed’.

Despite the increased availability and support for ICT integration, relatively few teachers integrate ICT into their teaching activities (Ertmer, 2005). One of the major problems of using Information Communication Technologies (ICTs) in education is to base choices on technological possibilities rather than educational needs. The educational effectiveness of ICTs depends on how they are used and for what purpose, like any other educational tool or mode of education delivery, ICTs do not work for everyone, everywhere in the same way (Mbodila et al. 2013). The available research has thus far mainly focused on isolated teacher related variables to explain the weak level of ICT integration and results show that prospective ICT integration significantly correlates with all teacher related variables, except for gender. Building on the results of a path analysis model, prospective ICT integration could be directly predicted on the base of teacher thinking variables (constructivist teaching beliefs, teacher self-efficacy, computer self-efficacy and computer attitudes in education), and indirectly by the gender of the student teachers (Guoyuan, Martin, Johan & Tondeur, 2010) but not perspectives of student teacher trainees and adoption on integration of ICTs which this study sought to investigate.

In some countries, notably the United States and Australia, there is evidence that sectors which have invested mostly in Information Communication and Technology (ICT) have experienced an increase in the overall efficiency of using labor and capital (Pilat, 2004).

Experience has proved that given proper infrastructure, ICT can be an enabler of socioeconomic development (Bhatnagar, 2005). ICTs have the potential to create job opportunities, improve delivery and access to health and education. They facilitate information sharing and knowledge creation. Education is one of the areas where integration of ICTs provides tangible benefits. Integration of ICTs in and for education is now seen worldwide both as a necessity and an opportunity (UNESCO, 2009). It plays a great role in the three fundamental aspects of education policy that is access, quality and cost. ICT increase access to education through distance learning. They provide new and innovative means to bring educational opportunities to a greater number of people of all ages, especially those who have historically been excluded such as the population living in rural areas, women facing social barriers and students with disabilities (UNESCO, 2009). Integration of ICTs in education promotes E-learning. E-learning is learning that is supported by electronic technology. It involves use of Interactive multimedia, Internet based learning (online), Computer mediated learning and campus portal access to institutional processes and resources (Taylor, 2001). However the question is; what is the perspective of student teacher trainees' preparedness and adoption on integration of ICTs?

To successfully initiate and implement integration of ICTs in Public Primary Teacher Training Colleges program depends strongly on the teachers' support and attitudes. It is believed that if teachers perceived technology programmes as neither fulfilling their needs nor their students' needs, it is likely that they will not integrate the technology into their teaching and learning. Among the factors that influence successful integration of ICTs into teaching are teachers' attitudes and beliefs towards integration of ICTs (Hew and Brush, 2007; Keengwe and Onchwari, 2008). If teachers' attitudes are positive toward integration of ICTs then they can easily provide useful insight about the adoption and integration of ICT into teaching and learning processes. Demici (2009) study revealed that though barriers such as lack of hardware and

software existed, teachers positive attitudes towards GIS was an important determinant to the successful integration of GIS into geography lessons.

Moreover, research has shown that teachers' attitudes towards technology influence their acceptance of the usefulness of technology and its integration into teaching, Huang & Liaw (2005). In European School net (2010) survey on teachers' use of Acer netbooks involving six European Union countries, many participants believed that the use of netbook had had positive impact on their learning, promoted individualized learning and helped to lengthen study beyond school day. However, evidence suggests that small number of teachers believe that the benefits of ICT are not clearly seen. The Empirical survey revealed that a fifth of European teachers believed that the use of ICT in teaching did not benefit their students' learning, Korte & Hüsing (2007). A survey of UK teachers also revealed that teachers' positivity about the possible contributions of ICT was moderated as they became 'rather more ambivalent and sometimes doubtful' about 'specific, current advantages', Becta (2008) whereas Mingaine (2013) study established that there was limited supply of qualified ICT teachers in Kenya and Mioduser, Turksapa and Leitner (2000) reported that demographic factors such as age, gender, teachers' experience and teachers' level of education greatly affected the speed at which ICT was conceived and implemented at Greece. Mbodila et al. (2013) argue that it is very important before implementing the integration and adoption of ICTs; to make sure that suitable levels of investment is in place, adequate training, good policy, careful planning, streamline the teaching process, and a systematic approach also are required when integrating ICTs in education in order to achieve maximum educational benefits. It is also vital to think carefully about purpose of education or the context in which the ICTs can be used before implementation. Grimus (2000) pointed out that "by teaching ICT skills students are prepared to face future development based on proper understanding". The above studies have been done in different contextual framework and not perspectives of student teacher trainees in preparedness and adoption in integrating ICTs in teaching and learning. The pertinent question one would ask is; what are the perspectives of student teacher trainees' preparedness on integration and adoption of ICTs in teaching and learning?

2. Findings of the study

The findings of the study were based on the objectives of the study.

2.1 Perspectives of teacher trainees' Preparedness in integrating ICT

The study sought to investigate the perspectives of student teacher trainees' preparedness in integrating ICT in teaching and learning process. According to the Ministry of Education Science and Technology (MoEST 2005) session paper No 1, teachers are an important resource in the teaching and learning process. Their preparedness therefore should enable them acquire sufficient subject mastery and pedagogy. Pearson moment Correlation analysis was conducted to establish the relationship between how student teacher trainees were being prepared to integrate ICT in their teaching career with how often they used internet in college to prepare for teaching especially during teaching practice. The result showed that there was a significant relationship ($r = 0.203$, $P\text{-value} = 0.001$). This implied that student teacher trainees who felt that they were prepared to integrate ICT in their teaching career often used internet in college especially

during teaching practice whereas those who felt that they were not prepared to integrate ICT in their teaching career especially in teaching practice never used internet in college for preparation for their teaching as shown on Table 1.

Table 1: Correlation results between student teacher trainees' preparation to integrate ICT with use of internet.

	Training preparation to integrate ICT in teaching career	Pearson Correlation	1	Use of internet in college for preparation in teaching
Training preparation to integrate ICT in teaching career				.203(**)
		Sig. (2-tailed)		.001
		N	295	290

** Correlation is significant at the 0.01 level (2-tailed).

Additionally, the study sought to find out why the correlation. An item in the student teacher trainees' questionnaire sought to find out if the training prepared them to integrate ICT in their teaching career. 70.4% felt that the training had prepared them to integrate ICT in teaching and learning process whereas 29.60% of the student teacher trainees felt that their training had not prepared them to integrate ICT in teaching and learning process as shown on Figure 1.

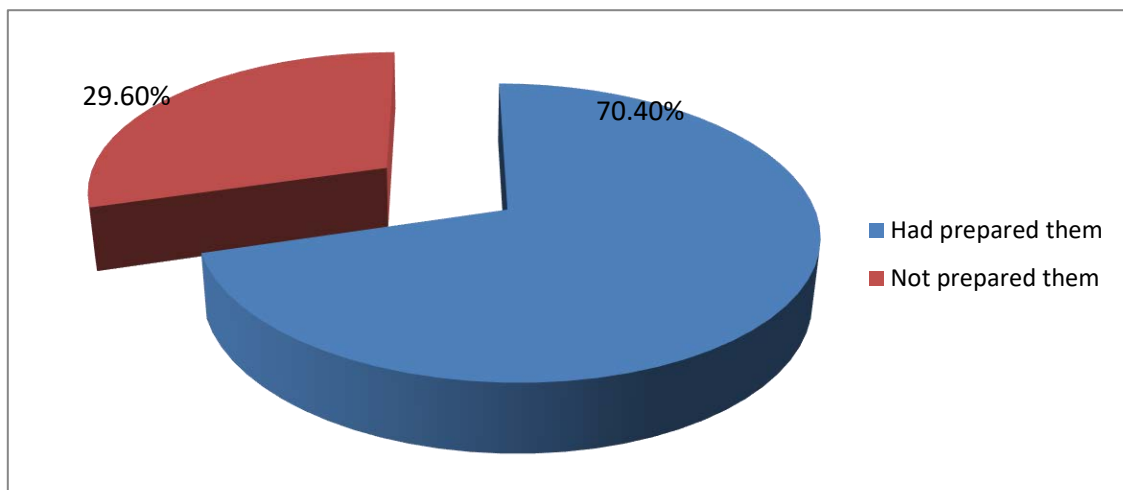


Figure 1: Student Teacher Trainees' opinion on trainings preparing them in integrating ICT.

Further, the study sought to establish reasons why student teacher trainees were for the opinion that they were adequately prepared. The student teacher trainees reported in a narrative form that they were adequately trained because they were able to use computers as they were taught basic skills in computer such as PowerPoint, access internet and get information, they were able to access teaching and learning materials and could make reference to textbooks comfortably, ICT was taught as a subject though not examinable, the Computer lessons were taught from first year up to 5th term of 2nd year. Moreover, at least

after training the student teacher trainee could try and operate computer programme but not competently, the knowledge student teacher trainees got in ICT was relevant in teaching and learning process and in the profession as a whole, the skills they had acquired in ICT would help in searching job opportunities and that the training allowed students teacher trainees to have knowledge on ICT and hence could teach the ICT subject easily or with easy in the teaching career.

The 29.60 % of the student teacher trainees felt that the training did not prepare them to integrate ICT in teaching and learning because they do not know how to operate a computer since the computers were very few for doing practical, there was limited time for practice, there was no training on integration during their ICT training programme, there were incomplete packages taught in college during the training, the teaching and learning resources needed to be equipped in the public teacher training colleges, student teacher trainees be trained on how to integrate, ICTs were inadequate, the student teacher trainees were being trained about basic skills on computer but not integration of ICTs.

Moreover, the research sought to find how student teacher trainees rated their skill level on integration of ICTs as they were being prepared as teacher professional. 47.5% of the student teacher trainees rated fair, 31.6% of the student teacher trainees rated good, 8.8% of the student teacher trainees rated excellent, 8.4% of the student teacher trainees rated very good whereas 3.0% of the student teacher trainees rated that they had no skill at all as shown on Table 2.

Table 2: Student Teacher Trainees' rating of the individual skill level on integration of ICT

Rating on the skill level	Number of Student Teacher trainees (N = 297)	%
No skill at all on integration	9	3.0
Good	94	31.6
Excellent	26	8.8
Fair	141	47.5
Very good	25	8.4
No answer	2	0.7

In addition, the study established why student teacher trainees rated their individual skills as good. They reported that they were good because they felt that they were able to access information using the available computers as they could operate them, able to use PowerPoint, access internet even by use of mobile phones, able to use text books, blackboards and could prepare and use charts in teaching. Those who felt their rating of the skills were low; were of the opinion that they had fair or no skills at all because accessibility to internet was low due to few computers compared to number of student teacher trainees as well as being irregularly taught computer lessons leave alone not well conversant with all the programs in the computer, fewer rooms for practical, ICTs were not enough for adequate preparation and negative attitude of some lecturers towards student teacher trainees' performance and progress. Further, observations from the observation scheduled showed that 60% of the tutors had negative attitude towards student teacher

trainees' performance and progress whereas 40% of the tutors had positive attitudes on student teacher trainees' performance and progress.

To confirm what had been reported by the student teacher trainees, the research used Pearson Moment Product correlation. The correlation results for the student teacher trainees' preparedness to integrate ICT in teaching and learning in their teaching career with their rating on skill level on integration of ICTs as they were being prepared as teacher professional showed that there was no significant relationship ($r = 0.102$, p -value = 0.082). This implied that student teacher trainees who had reported that they were prepared to integrate ICT in teaching and learning process in their teaching career still rated their skills to be fair or no skill at all as shown on Table 3.

Table 3: Correlation between student teacher trainee preparedness to integrate ICT and rating on skill level on integration of ICTs

		Training preparation to integrate ICT	Rating of skill level
Training preparation to integrate ICT	Pearson Correlation	1	.102
	Sig. (2- tailed)		.082
	N	295	293

The study drew a conclusion that that the training was only offering pedagogy, content, knowledge but not the technology which made integration a reality in the classroom setting.

Furthermore, the study sought KICD e- officers 'opinion on whether the student teacher trainees in primary teacher training colleges were well prepared for the integration of ICTs in teaching and learning. The entire KICD e-officer reported that the student teacher trainees were not well prepared because more training and exposure was required to prepare tutors and student teacher trainees during the training of trainer of trainees in Public Primary Teacher Training colleges (PPTTCs). The e-officers reported that student teacher trainees were still using manila papers yet computers were in colleges, digital content for use in primary was also PPTTCs and; tutors and student teacher trainees required utilization of the infrastructure to benefit from ICT integration.

Moreover, KICD e-officers opinion as curriculum developers on integration of ICTs in PPTTCs to enhance the same at the primary schools in Kenya were that; It was necessary to involve and train tutors in colleges so as to fully participate in teaching while integrating ICTs and student teacher trainees needed to acquire ICT skills in PPTTCs which they could impart at the primary schools. ICT devices required more training and exposure for the successful implementation of projects integration ICTs in teaching and learning.

2.1.1 Training in the teaching career

To confirm what had been reported student teacher trainees, further the study sought to establish whether student teacher trainees used internet in college for their preparation in teaching and learning especially during teaching practice. 75.8% of the student teacher trainees never used internet in college, 7.4% of the student teacher trainees used every time, 9.4% of the student teacher trainees used once a week, 4.4% of the student teacher trainees used once a month whereas 1.3% of the student teacher trainees used it once a year as shown on Table 4.

Table 4: How often student teacher trainees used internet in college for preparation in teaching during teaching practice

Usage of internet in college	No. of student teacher trainees (N = 297)	%
Every time	22	7.4
Once a week	28	9.4
Once a month	13	4.4
Once a year	4	1.3
Never	225	75.8
No answer	5	1.7

2.1.2 Skills required by the Tutors to prepare student teacher trainees

Since the study was on student teacher trainees' preparedness and adoption of ICTs, through principals of PPTTCs the study explored whether there had been any ICT training for tutors in the last three years in colleges to impart tutors with skills to prepare student teacher trainees on integration of ICTs. The principals revealed that they had been some form of ICT trainings for tutors once every term, two times or three times respectively. Further, an item in the principals' interview schedule sought to find out the principals' opinion on the skills required by the tutors to prepare student teacher trainees. The college principals in verbatim revealed that, for the tutors to prepare student teacher trainees on integration and adoption of ICTs, they required to use ICT tools and facilities, prepare teaching and learning resources, good communication skills, ICT proficiency teaching skills, internet manipulation skills, basic cabling and safety skills, computer skills, educational technology and adequate skills in ICT by being trained regularly and by being provided with desktops/laptops. The findings revealed lack of proper training in the use of ICTs. This concurs with Selwyn (2007)'s study on factors influencing integration of ICT in higher education in Vietnam which revealed that there was a poor slow uptake of ICT in education despite heavy investments put in place on integration of ICTs in education which was a similar case in Kenya.

The findings revealed that there was no significant relationship between training on use of ICTs and teacher trainees' rating on skill level on integration of ICTs as they are being prepared for their teaching career.

The negative correlation implied that those who were trained on use of ICTs tended to rate their skill as fair compared to those who were not trained. The overall statistics showed that there was no significant difference between training and teacher trainees' rating on skill level on integration of ICTs. The study therefore views that computers have not transformed practice and that access to ICTs is the foremost and necessary step in the integration process even though mere access will not automatically lead to integration of ICT for teaching and learning. Additionally, there was lack of proper training in the use of ICTs and that preparedness on integration and adoption of ICTs is at an infant stage. The study concluded that teacher trainees were not prepared to benefit from integration and adoption of ICTs to harness quality learning. This concurred with Maruti (2010) study on e-readiness. Moreover, the training programme did not provide prospective student teacher trainees with the necessary skills, competencies and experiences to prepare them to integrate ICTs effectively in their teaching profession. The study concurred with Mukiri, (2012); Omariba, Ayot & Ondigi (2016) study which revealed that teachers lacked proper training in the use of ICTs as they were not exposed to the use of ICT as a teaching resource in teaching despite the fact they had ICT qualifications which does not help them in lesson delivery.

Further, the study concurs with Duran (2000) & Omariba (2016) study on preparing technology- proficient teachers and Maruti (2010) study which revealed that teacher trainees lacked an allocated time within the college timetable when they could freely access computer labs to enforce practice as they were expected to have free time when they could access the facilities and put to practice what they had learned if integration of ICTs has to be realized in Kenyan PTTCs whereas Sherry & Gibson (2002) claim that technological, individual, organizational, and institutional factors should be considered when examining ICT adoption and integration. According to Olaniyi (2006), lack of computers and other resources in educational institutions is one of the factors that hinder student teacher trainees' preparedness in integrating and adoption of ICTs. The same was observed in Nigeria schools where the population of students was enormous while ICT facilities were inadequate. Most of the computers in the colleges are of low speed with a clock speed of 0.733GHz, hard disk memory of less than 10GB and RAM of 256MB. The PTTCs did not have software which were suited for integration development such Modular Object Oriented-Dynamic learning (MOODLE), Virtual Learning Environment (VLE), Blackboard and Shared Content Object Reference Model (SCORM). The colleges offered basic Microsoft office packages which gave student teacher trainees basic skills in computers but not integration and adoption of ICTs. Bowes (2003) notes that, to use these tools effectively and efficiently, teachers need visions of technologies' potential, opportunities to apply them, training, and just-in-time support and time to experiment only can then teachers be informed and confident in their use of ICTs whereas Collins and Jung (2003) observe that ICTs can be used as a core or complementary to the teacher training process if integration has to be realized.

2.2 The relationship between teacher trainees' training and their adoption on integrating ICTs.

The study sought to establish the relationship between student teacher trainees' training and their adoption on integrating ICTs into their instructional process. It is obvious that for teaching and learning to be efficient and effective, integration of ICTs is inevitable. The study explored student teacher trainees' opinion on the integration of ICTs. 77.8% of the student teacher trainees revealed that integration of ICTs

greatly enhanced content delivery, 75.4% of the student teacher trainees revealed that integration of ICTs influenced understanding of the content whereas 60.3% of the student teacher trainees disagreed that integration of ICTs in teaching was adding extra costs unnecessarily. When looking at the syllabus coverage, 59.6% of the student teacher trainees disagreed that integration of ICTs reduced syllabus coverage whereas 60.1% of the student teacher trainees reported that integration of ICTs in teaching was not adding extra costs unnecessarily as shown on Table 5.

Table 5: Student Teacher trainees' opinion on integration of ICT

Statements on ICT(N = 297)	Student Teacher Trainees' opinion					Mean
	SD	D	N	A	SA	
Integration of ICT in teaching is adding extra costs unnecessarily	112 (37.7%)	67 (22.6%)	34 (11.4%)	47 (15.8%)	26 (8.8%)	2.33
More time is spent when commuters are used	134 (45.1%)	89 (30.0%)	26 (8.8%)	32 (10.8%)	6 (2.0%)	1.91
Use of ICT reduces syllabus coverage	97 (32.7%)	80 (26.9%)	33 (11.1%)	49 (16.5%)	27 (9.1%)	2.40
Use of ICTs greatly enhances content delivery	15 (5.1%)	20 (6.7%)	19 (6.4%)	123 (41.4%)	108 (36.4%)	4.01
Use of ICTs in teaching influences understanding of the content	15 (5.1%)	18 (6.1%)	28 (9.4%)	120 (40.4%)	104 (35.0%)	3.98

Key: SD=strongly disagree, D=Disagree, N=Neutral, A= Agree, SA= strongly agree

Further, the study sought to establish how student teacher trainees expressed their opinion on integration ICTs in the training colleges. 24.2% of the student teacher trainees revealed there were ICTs in their colleges sometimes available whenever they needed them, 30.0% of the student teacher trainees revealed sometimes there was limited knowledge and skills on integration of computers in teaching, 25.9% of the student teacher trainees revealed they sometimes used computers to access specific education materials, 29.3% of the student teacher trainees liked browsing the internet to learn and get more information and 32.0% of the student teacher trainees had accessed the computers every time they were free. The result further showed that 35.0% of the student teacher trainees very rarely had enough time to use the ICTs whereas 31.3% of the student teacher trainees revealed computers in the colleges were very rarely used for teaching special subjects as shown on Table 6.

Table 6: Student Teacher trainee use of the ICTs

Statements on use of ICT (N = 297)	Student Teacher Trainees' Opinion				
	A	O	S	R	VR
ICTs are available whenever need arises	62 (20.9%)	53 (17.8%)	72 (24.2%)	67 (22.6%)	35 (11.8%)
There is limited knowledge and skills on integration of computers in teaching	63 (21.3%)	32 (10.8%)	89 (30.0%)	53 (17.8%)	34 (11.4%)
I use computers to access specific education materials	42 (14.1%)	48 (16.2%)	77 (25.9%)	47 (15.8%)	75 (25.3%)
I like browsing the internet to learn and get more information	87 (29.3%)	51 (17.2%)	67 (22.6%)	28 (9.4%)	56 (18.9%)
I have enough time to use computer	16 (5.4%)	29 (9.8%)	54 (18.2%)	86 (29.0%)	104 (35.0%)
I have access to computers every time I'm free	34 (11.4%)	33 (11.1%)	59 (19.9%)	60 (20.2%)	95 (32.0%)
Computers are used for teaching specific subjects	49 (16.5%)	39 (13.1%)	63 (21.2%)	39 (13.1%)	93 (31.3%)

A=Always, O=Occasionally, S=Sometimes, R=Rarely, VR=Very rarely

From the means shown on Table 6, the study concluded that the overall impression was that the integration and adoption of ICTs greatly enhanced content delivery (mean of 4.01 using the scale of 1-5).

In addition, the study sought to find out whether student teacher trainees were aware of an ICT policy in college. 59.6% of the student teacher trainees revealed colleges had an ICT policy, 38.7% of the student teacher trainees revealed colleges did not have any policy on ICT whereas 1.7% of the student teacher trainees had no answer. Moreover, the study established from student teacher trainees whether they were aware if the government had a policy on integration of ICT. 71.0% of the student teacher trainees reported they were aware of the government policy on integration of ICT, 27.9% of the student teacher trainees reported that they were not aware of the government policy on integration of ICT whereas 1.0% of the student teacher trainees had no answer as shown on Table 7.

Table 7: Presence of ICT policy

Policy on integration of ICT (N = 297)		f(N = 297)	%
College	Yes	177	59.6
	No	115	38.7
	No answer	5	1.7
Government policy on integration	Yes	211	71.0
	No	83	27.9
	No answer	3	1.0

Further, the study wanted to find out why student teacher trainees embraced the presence of a policy on integration of ICTs. The student teacher trainees gave various responses such as; all of the student teacher trainees in teacher's training colleges were entitled to learn ICTs, the government was providing computers to schools and colleges because it was aiming at transforming the analog era to digital era, the government policy on e-learning and the determination to make education more digital. All teachers had to be computer literate since the government wanted to introduce the issue of laptops in primary schools, ICT as a subject was timetabled and tested in the PPTTCs mock exams, certificates awarded and it was a must that all student teacher trainees had to pass all subjects including computer as a subject, and on buying computers the government had set the policy on the ratio of computer to the number of students going to use them.

However, student teacher trainees felt there was no policy on integration of ICT in colleges because the tutors were not always in a mood to help student teacher trainees to learn more on ICT, student teacher trainees had never seen any policy, the government was full of corruption and it was not easy to implement the policy and that the government had promised about the implementation of the laptop project but still there were no positive results seen concerning that project.

2.2.1 Conversance with ICT systems being propagated by Kenya Institute of Curriculum Development

Furthermore, the study sought to explore if student teacher trainees were conversant with ICT systems being propagated by Kenya Institute of Curriculum Development (KICD). An item in the student teacher trainees' questionnaire sought to find out if they were conversant with the ICT system being propagated by Kenya Institute of Curriculum Development (KICD). 56.20% of the student teacher trainees reported they were not conversant, 37.70% of the student teacher trainees reported they were conversant whereas 6.10% of the student teacher trainees had no answer as shown on figure 2.

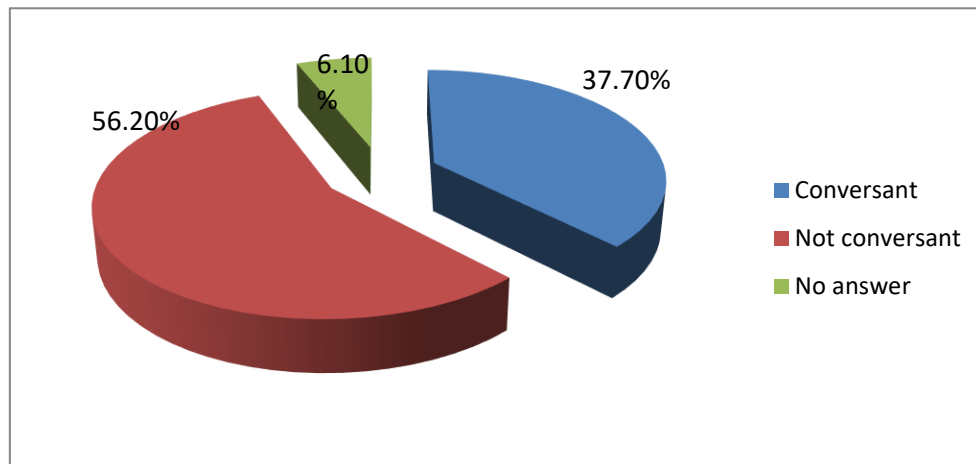


Figure 2: Student Teacher Trainee conversance with the ICT system being propagated by KICD

Moreover, the researcher wanted to know if the college principals were conversant with the systems propagated by KICD since they were the managers of colleges. The principals from the sampled colleges also confirmed that they were conversant with the ICT system being propagated by KICD. However, they revealed that these ICT systems were meant to help in preparation of content to be used in secondary schools. The principals' revelation concurs with Jesse, Jesse and Omariba (2016) study on the effect and user interface on the utilization and efficacy of educational digital content among secondary school in Kenya.

The study concluded therefore that the influence was both positive and negative. A crucial barrier to the integration of ICTs was ICT competence or skills and ICT confidence. A very significant determinant of teachers' levels of engagement in ICTs is their level of confidence in using technologies (Ratheeswari, 2018). Jones (2004) observes that age can influence the uptake of ICT for teaching whereas Cox et al. (2003) argues that the way ICTs were used in lessons was influenced by teachers' knowledge about their subject and how ICT was related to it. The findings revealed that there was no ICT policy in colleges to give guidelines on the integration of ICTs. Further, the government has not given clear guidelines on integration of ICTs especially in PTTCs. Student teacher trainees were not conversant with ICT systems being propagated by KICD. The concurred with Gode (2013) study on factors influencing integration of ICT in teacher training colleges. Prensky (2001) distinguishes between ICT natives who are born in a digital world and digital immigrants who must learn the digital language and for whom ICT will always be the second language. Further, he notes that the tutors' subject domain may influence the use of ICT.

2.3 Teacher trainees' attitude towards integration of ICTs

Furthermore, the study sought to find out teacher trainees' attitude towards integration of ICT. Ratings of student teacher trainees' attitude were done based on their responses towards the questionnaire variable items asked. In questionnaire item 1 and 2 which inquired; if integration of ICT added extra costs unnecessarily and if more time was spent for extra training for ICT respectively, all the student teacher trainees who accepted these items were taken to have a negative attitude and were coded 1. In questionnaire item 3, 4 and 5 (Use of ICTs greatly enhances content delivery, Use of ICT reduces syllabus coverage time and if use of ICTs in teaching influences understanding of the content), all student teacher trainees who

consented were taken to have positive attitude towards integrating ICT were coded 2. Further, a variable developed to establish the individual teacher trainees' attitudes based on the mean responses on the five items showed that; 75 (25.3%) of the student teacher trainees had negative attitude towards integrating ICTs whereas 222 (74.7%) of the student teacher trainees positive attitude.

The average attitude of the student teacher trainees in the study was calculated to be 1.63 with a standard deviation of 0.24 in the scale of 1 – 2 (1= negative, 2=positive). Using this scale, Analysis of variance (ANOVA) was conducted on the attitude of the student teacher trainees as determined by their skill levels on integration of ICTs as they are being prepared in the teaching profession. The results of the study showed that there was a significant relationship in the skill level on integration of ICTs by teacher trainees as they were being prepared as teacher professional ($F = 2.690$, $P \text{ value} = 0.031$) as shown on Table 8.

Table 8: ANOVA table for the student teacher trainees' attitude towards integration of ICT and their skill level ($N = 297$)

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.611	4	.153	2.690	.031
Within Groups	16.459	290	.057		
Total	17.069	294			

In addition, the study revealed that student teacher trainees who had negative attitude towards integration of ICTs had no skill at all with a mean of 1.49 whereas those who had positive attitudes towards integration of ICTs rated their skill levels to be good with a mean of 1.66. According to Judson (2006), there was little correlation between stated beliefs and the actual practice whereas Ertmer (in Hermans et al.; 2008) observe that teachers' educational beliefs can be barriers to the integration and adoption of ICT. One key area of teachers' attitudes towards ICT is their understanding of how it will benefit their work and their students' learning (Ratheeswari, 2018).

According to Almekhlafi (2016), positive attitudes encourage less technologically capable teachers to learn the skill necessary for the implementation of technology-based activities in the classroom. Teachers' perception of technology use also is affected by their belief about the way the subject content should be taught. However, Mueller et al. (2008) observe that positive attitudes towards ICT on learning will not automatically lead to the uptake of ICT integration in teaching and learning. Further, the results of the study showed that there was a significant relationship in the skill level on integration of ICTs by teacher trainees as they were being prepared as teacher professional. It further revealed that teacher trainees who had negative attitude towards integration of ICTs had no skill at all even though Judson (2006) observed that there was little correlation between stated beliefs and the actual practice.

2.4 Challenges faced by student teacher trainees' in an attempt to integrate ICT

The study sought to explore the challenges faced by student teacher trainees in an attempt to integrate of ICTs in teaching and learning problem. 19.4% of the student teacher trainees reported inadequate knowledge and skills on integration, 16.4% of the student teacher trainees reported lack of ICT materials or limited number of ICT materials, 14.4% of the student teacher trainees lack of inadequate time, 12.9% of the student teacher trainees reported inadequate power supplies which sometimes break connections and 10.9% of the student teacher trainees reported lack of facilities such as computer labs while others were in minimal percentages as shown in Table 9.

Table 9: Challenges faced by the student teacher trainees in an attempt to integrate ICT in teaching and learning

Challenges	Number of teacher trainees (N = 201)	%
Inadequate knowledge and skills on integration	39	19.4
Lack of ICT materials or Limited number of ICT materials	33	16.4
Lack of enough facilities such as computer labs.	22	10.9
Lack of funds and high costs of ICTs	8	4.0
Lack or inadequate time	29	14.4
Lack of computers or inadequate computers in colleges	21	10.4
High number of students in the lab during teaching	3	1.5
Inadequate power supply which sometimes break connections	26	12.9
Lack of security	2	1.0
Negative attitudes	4	2.0
Lack of enough teachers	5	2.5
Poor role model by lecturers	3	1.5

Unavailability of teachers	2	1.0
Bulky curriculum and it might be difficult to draw all required pictures	4	2.0
No training on integration of ICT	11	5.5
Expensive ICT materials	7	3.5
Inaccessibility to internet	3	1.5

To confirm what was established from student teacher trainees, the study found out from the principals the challenges of integrating ICTs in teaching in public primary teacher training colleges in Kenya. The principals revealed challenges such as inadequate ICT facilities in colleges, low levels of ICT literacy among tutors especially on use of modern ICTs, lack of appropriate and relevant content from publishers and the ministry, a pathy on usage of ICT in teaching learning process, some tutors ignore using the ICT facilities available and lack of ICT proficiency skills.

Moreover, principals were further asked to give suggestions regarding the challenges on integration of ICT in public primary teacher training colleges. The principals proposed the need to enhanced budgetary allocation for equipment and materials, have regular capacity building of staff and conduct in-service training of tutors on integration of ICT, enhance time tabling whereby ICT should be taken seriously and be incorporated in the curriculum and ICT as a subject to be examinable at Primary Teacher Education level.

The findings of the study therefore revealed numerous challenges such as; inadequate facilities, lack of competence, knowledge and skills in ICT integrations, limited time for accessing the computer in the college, power blackout, lack of support from college administration and government, college systems did not embrace integration of ICTs in all subjects, inadequate training, lack of enough ICTs and negative attitude of students, low levels of ICT literacy among tutors especially on use of modern ICTs, lack of appropriate and relevant content from publishers and the ministry, apathy on usage of ICT in teaching learning process, some tutors ignored using the ICT facilities available and initial preparation time is too long. These findings concurred earlier studies on ICT infrastructure in PPTTCs (Farrell, 2007 and Hennessy et al.2010). Maruti (2010) observed that it was evident that the presence or absence of ICT infrastructure was becoming a crucial factor in teachers' decision to use ICT in teaching. According to Gomes (2005), lack of technical support on integration affects the use of ICTs in teaching whereas Gutterman et al. (2009) notes that lack of quality teachers to apply ICT to the existing education systems to poor policy framework for integration of ICT. Tong and Trinidad (2010) observes that without technical support for teachers, they become frustrated resulting in their unwillingness to integrate ICT to teach.

3. Conclusion

The main question that this study endeavored to find was an answer to the student teacher trainees' preparedness to integrate information communication technology in teaching and learning. Based on the findings of the study, this study resulted in the following main conclusions:

- a) Teacher trainees did not access computers during free time and other ICTs to enable them to integrate in teaching and learning process. This implied that student teacher trainees did not have access to the internet which meant that rolling out on integration was impeded to a large extent by inadequate infrastructure.
- b) The researcher viewed that student teacher trainees were not prepared to benefit from integration of ICT to harness quality learning given that curriculum delivery was done in classrooms which were not ICT friendly. Further, the study viewed that ICTs were to a large extent not aiding curriculum delivery in PPTTCs and therefore the student teacher trainees lacked exposure on integration as they were being prepared in their teaching career.
- c) Adequacy of ICTs influences adoption of ICT in the process of teaching and learning. Integration therefore should go beyond the use of basic computer packages and textbooks for delivering subject specific content if integration has to be rolled out.

Bereiter (2002) observes that; "Learning is facilitated when new knowledge is integrated into the learners' world..." This study will give educators a better understanding of the importance of integrating ICT in the process of teaching and learning especially in PPTTCs.

4. Recommendations

The following recommendations were made based on the findings of the study.

- a) Teachers must have the knowledge and skills to use the ICTs and resources to help all students achieve high academic standards. Therefore, the curriculum in PPTTCs should be revised to include integration of ICTs as a subject in the syllabus which should be examinable at primary teacher examination. This will enhance the development of integration of ICTs, design and development skills, and pedagogical strategies.
- b) Kenyan PPTTCs curriculum should train student teacher trainees on how to integrate ICTs in their classrooms by being engaged in the process of ICT-integrated training. Further, promote ICT-pedagogy integration in their teaching by providing ICT-based training environments where on-demand access to materials; peers, and networks of experts where expertise and advices can be obtained and active discussion can take place in relation to technology and pedagogy. (This approach of using ICTs to support teachers' on-going professional development and networking can be very effective as long as organized support is provided, Pace, 1999).
- c) High quality, meaningful, and culturally responsive digital content must be generated and be available for student teachers trainees in their teaching practices. For many teacher education programmes, this formidable task requires the acquisition of new resources, expertise and careful planning. PPTTCs should hence establish strategies in integration of various ICTs with a view to adapt and embrace them in the process of teaching and learning.

- d) There is a critical need of context, culture, leadership and vision, lifelong learning, and the change process in planning for the integration of ICTs into teacher education; PPTCs administration should therefore develop ICTs policy to guide student teacher trainees on integration, embrace and support integration of ICTs in teaching and learning.
- e) The ICT competencies required of student teacher trainees relate to content, pedagogy, technical issues, collaboration, and networking. PPTTCs should therefore adopt policies that guide them on integration of ICTs in the process of teaching and learning and one of the mandatory policies to be adopted is to ensure online ICT competency for both tutors and student teacher trainees.
- f) There is need to develop standards to guide implementation of ICTs in teacher education. Kenya Institute of Curriculum Development (KICD) should therefore develop and supply the public primary teacher training colleges with relevant e-content in all subject areas to ensure delivery of the curriculum is integrated with ICTs. Further, The KICD should come up with clear guidelines on integration of ICTs in PPTTCs if Kenyan outputs from PPTTCs have to be relevant with the demands of the global job market.
- g) The study established inadequate facilities in the colleges. There is need for essential conditions for successful integration of ICTs into teacher education. Thus, important strategies need to be considered in planning for the integration and adoption of ICTs in teacher education and managing the change process. Further, the study recommends the MoEST to initiate partnership with private sectors to equip PPTTCs with infrastructure to enhance ICT friendly classrooms and install internet in PPTTCs through partnership with private sectors to pay for the substantial costs to ensure secure and continual internet connectivity. Moreover, the Ministry of Education should develop an ICT policy on integration of ICTs in teaching and learning for PTTCs and ensure it is implemented to the later.

4.1 Future Research Directions

A study on guidelines on student teacher trainees' training in tertiary institutions.

Realizing the effect of ICT on the workplace and everyday life, today's tertiary institutions need guidelines to restructure their educational curricula and classroom facilities in order to bridge the existing technology gap in teaching and learning. Restructuring requires effective integration of technologies into the existing environment to promote meaningful learning and enhance productivity.

5. Acknowledgement

The research was financed by me during a graduate study.

6. References

- Almekhlafi, A. G. A. (2016). Preservice and in-service teachers' perceptions of the utility of e-learning. Digital collaboration tools for teaching and learning. Retrieved on 8th April 2020 from *Journal of education and Social Sciences*, Vol. 4, (June)ISSN 2289-9855

- Becta (2008). *Harnessing Technology: Schools Survey 2008*. Retrieved October 20, 2011 from http://emergingtechnologies.becta.org.uk/uploaddir/downloads/page_documents/research/ht_schools_survey08_analysis.pdf
- Bowes, J. (2003). *The emerging repertoire demanded of teachers of the future: Surviving the transition*. Retrieved, September 1, 2004, from <http://crpit.com/confpapers/CRPITV23Bowes.pdf>
- Collins, B., and Jung, I. S. (2003). Uses of information and communication technologies in teacher education. In B. Robinson & C. Latchem (eds); *Teacher education through open and distance learning*. London: Routledge Falmer
- Commission of European Communities,(2008). *The use of ICT to support innovation and lifelong learning for all. A progress report*. Retrieved April 5, 2008 from <http://ec.europa.eu/education/lifelonglearning/programme/doc/sec2629.pdf>
- Cox, M.J., Webb, M., Abbott, C., Blakeley, B., Beauchamp, J. and Rhodes, V. (2003). *ICT and Pedagogy-a review of the research Literature*. London: BECTA/Df ES
- Demici, A. (2009). How do Teachers Approach New Technologies: Geography Teachers' Attitudes towards Geographic Information Systems (GIS). *European Journal of Educational Studies*, vol. 1, no.1.
- Duran, M. (2000). Preparing technology-proficient teachers: In C. Crawford et al.(eds), *Proceedings of society for Information Technology and Teacher Education. International Conference*. 2000, 1343-1348, Chesapeake, VA: AACE
- Ertmer, P.A. (2005). Teacher Pedagogical Beliefs: The Final Frontier in our Quest for Technology Integration? *Educational Development Research and Development*, 53, 25-39
- Farrell, G. (2007). *Survey of ICT and Education in Africa: Kenya Country Report*. Washington, DC: World Bank.
- Farrell, G. and Shafika, I. (2007). *Survey of ICT and education in Africa. Summary report based on 53 countries*, Washington D.C, <http://www.infodev.org/lentpublications.353.html>
- Gode, V. O. (2013). *Factors Influencing Integration of Information and Communication Technologies in Public Primary Teacher Training in Central Region of Kenya*. Unpublished Master's Thesis- Kisii University

- Gomes, C. (2005). Integrating of ICT in Science teaching: A study performed in Azores, Portugal. *Recent Research Development in Learning Technologies*
- Gulbahar, Y. (2007). *Technology Planning: A roadmap to successful technology integration in schools. Computers and Education*, 49(4), 943-956
- Guoyuan, S.; Martin, V.; Johan, V. B. and JO Tundeur (2010). Student Teachers' Thinking Process and ICT Integration: Predictors of Prospective teaching with Educational Technology. Elsevier Ltd
- Gutterman, B., Rahman, S., Supelano, J., Laura, T. and Mai, Y. (2009). *Global Alliance for ICT and Development*: New York
- Grimus, M. (200, 21-25 Aug). 'ICT and multimedia in the primary school. Paper presented at the 16th conference on education uses of information and communication technologies', Beijing, China
- Hew, K. F., & Brush, T. (2007). Integrating technology into K-12 teaching and learning: Current knowledge gaps and recommendations for future research. *Educational Technology Research and Development*, vol. 55, pp. 223-253.
- Hennessy, S., Onguko, B., Harrison, Ang'ondi, Namalefe, Naseem and Wamakote. (2010). *Developing use of ICT to enhance teaching and learning in east African Schools A review of the Literature*. Cambridge, UK and Dar es Salaam, Tanzania: Faculty of Education, University of Cambridge and Aga Khan University, Institute for Educational Development – Eastern Africa
- Hermans, R., Tondeur, J., van Braak, J., & Vackle, M. (2008). *The Impact of Primary School Teacher's Education Beliefs on the Classroom Use of Computers and Education*, 51(4), 1499-1509
- Huang, H. M. and Liaw, S. S. (2005). Exploring users' attitudes and intentions toward the Web as a survey tool. *Computers in Human Behavior*, vol. 21, no. 5, pp.729-743
International Society for Technology and Education
- International Institute for Communication and Development (2007). *People - ICT – Development*. Hague. Netherlands
- Jones, A. (2004). A review of the research literature on barriers to uptake of ICT by teachers: *British Educational Communications and Technology Agency (becta)*

- Judson, E. (2006). How teachers integrate technology and their beliefs about learning: Is there connections? *Journal of Technology and Teacher Education*. 14,581-597
- Keengwe, J., and Onchwari, G. (2008). Computer technology integration and student learning: Barriers and promise, *Journal of Science Education and Technology*, vol. 17, pp. 560–565
- Korte, W.B.,and Husing, T. (2007). Benchmarking access and use of ICT in European schools 2006: Results from Head teacher and a classroom surveys in 27 European countries, *elearning papers*, vol. 29, no. 10, pp. 1-6
- Maruti, J. S. (2010). *E-Learning among Public Primary Teacher Training Colleges in Kenya*. <http://www.kenet.org.ke/e-readness>
- Mbodila, M.; Jones, T. and Muhandji, K. (2013). Integration of ICT in Education: Key Challenges. *International Journal of Emerging Technology and Advanced Engineering*. Retrieved on 8th April 2020 from www.ijetae.com Volume 3, Issue 11, November 2013
- Mingaine, L.(2013). Skill challenges in Adoption and use ICT in public secondary schools, Kenya. *International Journal of Humanities and Social Science*.Vol.3 No.13; July 2013
- Mioduser, D. Tur-Kaspa. H. and LeitnerI .(2000). The learning value of Computer based instruction of early reading skills. *Journal of computer assistant learning*, 16(1) 54 – 63 Monica: Milken International
- MOEST, (2005). *Kenya ICT Education and Option Paper of 2005*. Nairobi
- Mukiri, I. M. (2012). Preparedness of Mathematics teachers for teaching Mathematics Using ICT in secondary schools on Tigania East District, Kenya. *A paper presented in the 3rd International Conference held in Kenyatta University, July 10th to 12th, 2013*
- Mueller, J., Wood, E., Willoughy, T., Ross, C., and Specht, T. (2008). *Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration*. *Computers and Education*, 51(4), 1523-1537
- Mumtaz, S. (2000). Factors Affecting Teachers' Use of Information and Communications Technology: a review of the literature. *Journal of Information Technology for Teacher Education*,9(3), 319-342
- Olaniyi, S. S. (2006) .E-learning technology: The Nigeria Experience
Retrieved July,2017 from <http://www.fig.net/pub/fig2006/paper/ts84-o3>

- Omariba, A. (2016). Teachers Preparedness in Integrating Information Communication Technology in Training Teachers in Public Primary Teacher Training Colleges in Central Region Kenya, Kenyatta University, Unpublished Thesis
- Omariba, A; Ayot, H. and S. Ondigi, S. (2016.). Teachers' preparedness in integrating ICT in public teacher training colleges in Kenya. *International Journal of Education and Research* Vol. 4 No. 9 September 2016, **201-212**, www.ijer.net
- Pace, L. (1999). *Integration of information and communication technologies (ICTs) through teacher professional development: Comparative analysis of issues and trends in seven APEC economies*. Canada: Judy Roberts & Associates Inc
- Pilat, D. (2004). "The Economic Impacts of ICT: A European Perspective," IIR Working Paper 05-07, Institute of Innovation Research, Hitotsubashi University.
- Prensky, M. (2001). *Digital natives, digital immigrants*. *On the Horizon*, 9(5), 1-3
- Ratheeswari, K. (2018). Information Communication Technology in Education. *Journal of Applied and Advanced Research*, 2018: 3(Suppl. 1) S45-S47. Retrieved on 8th April 2020 from <https://dx.doi.org/10.21839/jaar.2018.v3S1.169>.
- Selwyn, N. (2007). The use of computer technology in university teaching and learning: a critical perspective. *Journal of Computer Assisted Learning*, 23(2), 83-94
- Sherry, L., and Gibson, D. (2002). The path to teacher leadership in educational technology. *Contemporary issues in technology and teacher education*, vol. 2, no. 2, pp. 178-203.
- Taylor, L. (2004). How student teachers develop their understanding of teaching using ICT. *Journal of Education for Teaching*. 30(1), 43-56.
- Tong, K.P., and Trinidad, S.G.(2005). Constraints and Conditions of Sustainable Innovative Pedagogical Practices using Technology. *Journal of International Electronic for leadership in learning*, 9(3), 1-27
- UNESCO (2009). *Information and communication technologies in teacher education: a planning guide*. France (Paris) UNESCO.

Appendix

Key terms and Definitions

Adoption- Is the decision of an individual to make use of technology as the best course of action available.

Information Communication Technologies- Encompasses the range of hardware (desktop and portable computers, projection technology, calculators, data-logging, and digital-recording equipment), software applications (generic software, multimedia resources), and information systems (Intranet, Internet) available in colleges.

Integration- Is the adoption, inclusion and use of resource materials/equipment to aid the process of teaching and learning.

Preparedness: Training in readiness to fully integrate technology in teaching and learning.

Pre-service training institution: Institutions for students' training to be professional teachers.

Academic League of Urgency and Emergency Nursing as A Health Educational Tool: Experience Report

Henrique Cordeiro de Carvalho

Nursing Student. Federal University of Uberlandia, Minas Gerais State, Brazil.

OMAR PEREIRA DE ALMEIDA NETO

PhD. Professor at Department of Medicine. Federal University of Uberlandia, Minas Gerais State, Brazil.

Suely Amorim de Araújo

PhD. Professor at Nursing Department, Medicine School, Federal University of Uberlandia, Minas Gerais State, Brazil.

Ricardo Gonçalves de Holanda

Physician. Professor at Technical School of Health, Federal University of Uberlandia, Minas Gerais State, Brazil.

ABSTRACT

Introduction: Academic leagues are created with the proposal of expanding the studies on certain fields as an educational tool. **Objective:** Describing experience of nursing students as member of activities in a Nursing Urgency and Emergency League in a Public University of Minas Gerais State, Brazil. **Methodology:** Exploratory and descriptive study of the type experience report of nursing student participating in the League of Urgency and Emergency in Nursing called "LUREEN", within the scope of the Federal University of Uberlandia (UFU). **Results:** Nursing students have taught by two professors. One of them has multiprofessional degree (nurse, physician and dental surgeon, besides master degree) and other is PhD in Nursing. A total of 20 students make up league team, most female (n=14; 70%) with a mean age of 23.80 ± 4.10 years and attending the 6th period of nursing course (n=6; 30%). The main activities performed were: Classes and realistic clinical simulations through educational methodologies as Team-Based Learning (TBL), Problem Based Learning (PBL) and Case-based learning (CBL); Health Continuous Education; Extra hospital activities and Coverage of cultural and sportive events by league. **Final Considerations:** The outcomes presented in that experience report show a great way to improve and increasing learning of nursing students in undergraduate through an academic league as well as one of the best methodologies to provide real training in urgency and emergency situations. It is expected that future studies approach similar issues to improve nurse education courses.

Keywords: Education; Nursing; Health; Emergency Relief.

Introduction

Emergency services aim to attend occurrences as quickly as possible after exposure of the victim to agents that cause injury to health. Clinical, surgical, traumatic, obstetric, psychiatric among others are considered urgent. Emergency medical service in Brazil are composed of basic team as physician and nursing staff (BRASIL, 2019).

Surgical situations are frequent demands in pre-hospital emergency services. Traumas responsible for nine deaths every minute around the world and are defined as high energy transfer or barrier in the normal flow of energy (mechanical, chemical, thermal, radiation energy, electrical) from an object to the human body (NAEMT, 2017).

Knowlagent building of professionals who will work in emergency services begins at undergraduate. Educational tools such as active teaching methodologies learning and involvement of students in activities related to the area are fundamental for the construction of knowledge regarding trauma care. One of these tools is academic study teams calls “*Liga Acadêmica*” in Brazil (NAEMT, 2017).

The academic leagues are created with the proposal of expanding the studies on certain topics seen during graduation in a more specific way, they are an extracurricular extension activity that has the participation of students and teachers, who are responsible for guiding the activities carried out in the leagues (DANTAS, 2017).

These activities involve any league-related content, such as classes, lectures, training, and scientific events. As practices allow to deepen the knowledge of students, which improves the teaching-learning process in the university sphere and collaborates with the professional training of the academic (DANTAS, 2017).

In urgency and emergency field, academic leagues allow the recognition of risk situations by the student and future professionals through the association between what is studied in theory and what is applicable in practice. In addition, the leagues also have importance in relation to the community, as health education activities are carried out focused on the conducts necessary in certain kind of traumatic situations (SOUZA, 2014).

Another aspect that is important to emphasize is that in addition to the leagues being of great importance in the education of the academic, they enhance the training of nurses, help in the development of critical reasoning and improve the decision-making capacity which are essential aspects in care related to urgency and emergency (QUEIROZ, 2014).

In that way, showing importance of academic leagues in the teaching learning process, this study aims to describe the experience of nursing students as member of activities in a Nursing Urgency and Emergency League in a Public University of Minas Gerais State, Brazil.

Methods

Type of Study

Exploratory descriptive study of the type experience report. The experience report aims to describe how the experience in a particular work environment or study is, therefore, contributes to the training of

the nursing professional, besides promoting perceptions and reflections in relation to what is witnessed (QUEIROZ, 2014).

This type of study is a document that describe a period of activities during a period of time of graduation, it should present on the subject reported with bibliographic data, exposing its objectives and bringing a general overview on the subject. During the development of experience report, is necessary to use theoretical bases and scientific data that relate the theme and compare with other scientific researches. It should also be detailed the activities performed according to the report in order to be able to meet the objectives of the study, and to evidence the positive and negative aspects of the study (CESCAGE, 2014).

Thus, the report allows the future nurse a more detailed and directed view in relation to hospital and extra-hospital emergency services (QUEIROZ, 2014).

Study Site

The study reports the experience of the nursing student participating in the League of Urgency and Emergency in Nursing called “LUREEN”, within the scope of the Federal University of Uberlandia (UFU), with the purpose of developing learning and motivating the members of the academic league through research and extensions in the area of nursing in urgency and emergency.

LUREEN has created in 2009. Among the activities provided by the league are the short courses, classes, lectures and practical activities of LUREEN members in the hospital and extra-hospital areas, which are carried out in partnerships with companies that work in the emergency and emergency services.

LUREEN has student members and two coordinator professors. who are also responsible for teaching classes on urgent and emergency issues. In order to student get in league, a test is prepared by LUREEN members is carried out. The test contains multiple choice questions and addresses about pre-hospital care.

In addition to the objective test, an interview of the candidates with the effective members of the league is also conducted to assess whether they have the appropriate selection criteria for the interests of the league. To join LUREEN, it is necessary that candidates have been approved in the discipline of nursing fundamentals, which is taught in the 4th period of nursing undergraduate, being able to perform some of the necessary procedures in clinical practice and internships.

EXPERIENCE REPORT

Nursing students have taught by two professors. One of them has multiprofessional degree (nurse, physician and dental surgeon, besides master degree) and other is PhD in Nursing. A total of 20 students make up league team, most female (n=14; 70%) with a mean age of 23.80 ± 4.10 years and attending the 6th period of nursing course (n=6; 30%). The table below presents a brief profile with continuous and categorical quantitative data about LUREEN students.

Table 1. Profile of the participants of the League of Urgency and Emergency in Nursing of the Federal University of Uberlandia - MG, 2020.

Variable	n	%	Minimum	Maximum	Mean±SD
Gender					
Male	6	30	-	-	-
Female	14	70	-	-	-
Nursing course Stage					
3rd	1	5	-	-	-
4th	1	5	-	-	-
5th	1	5	-	-	-
6th	3	15	-	-	-
7th	4	20	-	-	-
8th	2	10	-	-	-
9th	6	30	-	-	-
10th	2	10	-	-	-
Age	-	-	19	36	23,80±4,10

During the participation of the student as an effective member of LUREEN, several activities based on the pillars of teaching, research and extension were carried out. The results include activities related to expository classes in which the student actively participated as a listener, in order to optimize the learning process about themes inherent to the league, as well as processes of continuing education in health, practical experiences in urgency and emergency and scientific events promoted by the league

Classes and realistic clinical simulations

The lectures are a form of didactic strategy that has as its main characteristic the exposure of a content by someone who has knowledge about a particular subject (LEAL, 2009). At LUREEN meetings, the lectures are held at the time of the weekly meetings, with a variable duration according to the available time of the participants, which lasts approximately one hour.

Such classes are of the expository type dialogued and also use active methodologies such as *Team-Based Learning (TBL)*, *Problem Based Learning (PBL)* and *Case-based learning (CBL)*. At this time, the other members can make contributions, questions, suggestions and debate on the theme being taught. The active methodologies mentioned facilitate the interaction between students and teachers, placing the learner as a teaching center (MUSSELIN et al., 2020).

The teacher responsible for preparing and teaching the classes is the same one who accompanies LUREEN meetings, being able to identify which subjects are most in need of being treated and the relevance in the professional training of nursing students in the context of urgency and emergency. The members of the league also contribute to their own experiences experienced during the undergraduate periods, both in practical classes and in internships, about situations and conducts taken in the face of some scenarios witnessed in the profession.

Extensive content about the types of shocks (loss of oxygenation of the cells of the body caused by absence of tissue perfusion, which leads to loss of vital energy production for humans) and their clinical approaches were given to students. The team was able to differentiate the main types of shock (hypovolemic, distributive and cardiogenic) as well as the main clinical approaches in the management of each emergency situation (NAEMT, 2017).

In the area of urgency and emergency, it is of great importance that professionals and students know how to recognize the types of shock and which conducts should be taken. During the lesson, the teacher brings examples of situations that may occur or that have already happened in care. These examples serve as a starting point for discussions and develop clinical reasoning, which is essential in the nursing profession. It was also discussed in the class about shock, which approaches should be made immediately during hospital care. The students make suggestions of different behaviors and the teacher leads to mistakes and correct answers.

Another topic that generated a lot of curiosity and interest among the student team was the topic of discussion of acute coronary syndrome (a clinical condition that may involve ischemia and acute myocardial infarction, which coincides with a high risk of death and sequelae to the patient) (ANDRADE, 2014).

In this item, the responsible teacher performed clinical simulations using the league members themselves. The teacher simulated a situation of a victim with chest pain and how the care should be in this scenario. This type of methodology stimulates the decision-making and clinical reasoning of the student, besides being made in a safe and controlled environment, where situations can be placed in a way that prepares the future professional for patient care (FERNANDES, 2019).

The use of simulation as a teaching strategy promoted the development of teamwork to the members of the league, since in the professional environment this form of care is common place and necessary for good clinical outcomes (SILVA, 2018).

In addition to the simulation being used to teach the class about acute coronary syndrome the coordinating professor also used it to address the subject of immobilizations and evaluation of the scene of a possible trauma (evaluation of the scene, and immobilization of the victim). University health skills laboratories were used to enrich the practice.

The evaluation of the scene is one of the first steps performed by the rescuer before performing a care, from the collection of information in pre-hospital care itself made to promote the safety of the scene, identify the causes of the incident and observe the behavior of the people around the occurrence. Safety and situation are the main points of the scene evaluation, where it becomes possible to analyze the context of the occurrence and the conditions of the site. In this way the professional can better conduct the care and prevent the patient's condition from worsening, as well as the safety of the professional who is at the scene. During the practical class, the students screened victim lying on the floor and performed cervical spine stabilization and cervical collar use, as one of the protocols for the care of basic life support in trauma (GALA; CRANDALL, 2019).

The concepts addressed in this practical class contribute to the fact that students know how to proceed in the face of an occurrence similar to that which was simulated. This reinforces the need to

reconcile the lectures with the practical training to improve performance and decision-making in hospital practice.

Health Continuous Education

One of LUREEN's goals set out in the statute created together with the league's foundation is to provide contact between under graduate students and local community. LUREEN carries out continuing education and health education activities to promote knowledge about urgent and emergency situations and how the population should act in such situations.

Health education is defined as the practice of activities aimed at changing behavior in relation to health, based on evidence-based analyses on the subject addressed (SANTOS, 2018). LUREEN used health education to promote training for professionals in the "*Casa da Árvore*" Learning Community in Uberlandia, Minas Gerais.

The objective of this training was to prepare teachers working in the institution to act appropriately in situations that may occur in daily life, both with community students and with professionals. The activity was planned in a meeting with the league members.

It was decided that four LUREEN participants were responsible for conducting the activity in question, the themes were selected according to the Pre-Hospital Support of Life in Trauma (PHTLS) and dealt with basic life support, a set of conducts and procedures without the use of invasive devices, in order to identify situations of laughter to life and provide a viable condition for the victim until she was transported to a hospital (PEREIRA, 2019).

In relation to the methodology used for the work, slide shows were elaborated on the themes: Airway Obstruction, Cardiopulmonary Resuscitation (CPR), Fractures and Falls, Bites, Burns, Epistaxis and Seizures. The dynamics for conducting the subjects dealt with was in conversation wheel, to promote interaction between the members of the league and the professionals of the Community, lasting approximately one hour. After the presentation of the content and clarification of doubts, a part of practical simulations on cardiopulmonary resuscitation and obstruction airway were conducted with the dolls manufactured by LUREEN itself in the project "*Recycle to Revive*".

The project "*Recycle to Revive*" was carried out by the league in order to make the dolls themselves from recyclable materials, since the value to acquire a cardiopulmonary resuscitation training dummy is high, but the material is necessary for LUREEN practices and trainings. The materials used in the making of dolls are used clothes, disposable bottles, paper and lines that together allow the training of various clinical maneuvers.

At the end of the simulation with the dolls, the league ended the activity with the clarification of new doubts and obtained feedback from the participants of the action. It was possible to notice that some of the concepts and situations portrayed on the day in question needed to be improved by the teachers, because they reported inappropriate conduct in the face of possible occurrences.

Thus, the need and importance of health training and education for the community is reinforced, because the information disclosed in these studies influences the general condition of the victim and enables a faster and safer recovery.

Following the same aspect of health education, LUREEN promoted, in the second half of 2019, the *1st Multiprofessional Symposium on Urgency and Emergency*, of the Federal University of Uberlandia, an event held by the members of the league with the coordination of guiding professors in order to address the most recurrent themes about urgency and emergency in the form of lectures, in addition to offering different short courses for the participants of the scientific event made by league members.

The topics covered in the lectures were: "*Manchester Classification*"; "*Psychiatric Emergencies and Emergencies*"; "*Assistance in outside hospital situations*"; "*Obstetric Emergencies and Emergencies*"; "*Pediatric Emergencies and Emergencies*"; "*Fracture Immobilization*"; "*Update on Advanced Life Support in Cardiology*".

The lecture on "Manchester Classification" addressed the Manchester Screening System, which is a form of clinical risk classification of patients to set priorities in care. This division is made through the colors red, orange, yellow, green and blue, each with an emergency determination, which suggests faster patient care (ANZILIERO, 2016).

Then, the exposition on "Psychiatric Emergencies and Emergencies" addressed different types of situations that can occur anywhere and how to identify a psychiatric emergency. The speaker used clinical cases as a form of interaction with the audience present. Psychiatric emergencies are a form of change in behavior, thinking or mood, it is common in cases of patients with psychiatric disorders and require professionals to know how to identify such occurrences (NASCIMENTO, 2019).

The last presentation in the morning was about outside hospital situation, identifying the main equipment present in an ambulance and its purposes. The lecture was conducted by one of the nurses working in a private emergency medical services company and had a realistic simulation within the presentation place of the lectures, in order to promote to the listeners a situation close to the real one of an occurrences.

In addition, another product of this event was the realization of short courses. Each short course had presentations on the subject addressed and practices on emergency situations, lasting approximately two hours. The responsible for conducting the classes were the teachers of the nursing course of the UFU and nurses invited by LUREEN, in addition to the participation of the Military Fire Department of Minas Gerais, in charge of ministering on CPR with the participants of the event.

The *1st Multiprofessional Symposium on Urgency and Emergency* was closed with presentations of papers that dealt with the main theme of the event, chosen according to the relevance to the subject. In general, the objectives proposed by LUREEN with the symposium were fulfilled, as it led to information that is useful in everyday life, not only of the students of the university, but also of all the people who were interested in the subject. After being sent a questionnaire to the participants about the positive and negative points of the event, it was noticed that the vast majority of those who answered found the event satisfactory and were able to learn more about urgency and emergency, which reinforces the importance of health education and promotion of scientific events at the university level.

Extra hospital activities

According to Article number 5 of the statute of the League of Urgency and Emergency in Nursing, it is part of the objectives to provide practical activities to LUREEN members in the hospital and extra-

hospital area through partnerships, always aiming at learning. One of these partnerships is made with an emergency care company in Uberlandia, LUREEN members follow the occurrences with the supervision of the nurse who is scheduled to be on duty.

The division of students in the company is done by the availability of each member of the league, and can be individually or in pairs in the attendances. A scale was set up with interested academics lasting five hours per week.

In addition to the attendances witnessed, the company also promotes continuing education classes regarding rescues and immobilizations, which are provided by the company's coordinating nurse. One of these classes was taught to the Brazilian Army, in a mini-course of first responders to improve soldiers and cables working in regions near Uberlandia.

Among the types of care most performed by the team, which consists of a nurse, a first-aid driver and a doctor, are the transportation of patients who are discharged from hospitals, visits to employees of other establishments that maintain ties with the company, and rescues of domestic or automobile accidents from the population that requests the company's service.

The transports are performed following the necessary recommendations of patient restraint to promote greater safety and well-being during the journey. The transport of the patient begins as soon as the patient is packed in the ambulance, this process has relevance in the recovery of the victim and is considered a fundamental aspect in the definitive treatment at the scene, since an injury can become more severe as time passes (NAEMT, 2017; GALA; CRANDALL, 2019).

On the other hand, the visits to employees of other companies are made according to the specific need of each case, such as headache, contractures and other spontaneous demands. In relation to the services provided to the population, the students were able to witness an occurrence on fractures, which are divided into closed and exposed. Closed fractures are those in which the broken bone does not pierce the integrity of the skin, and the exposed fractures are those that occur laceration of the muscle and skin due to the cutting end of the fractured bone (GALA; CRANDALL, 2019). The nurse responsible for the care performed the immobilization of the fracture with malleable splint, treatment of the patient's pain with morphine, movement in the victim's block for positioning on the board and transportation to a specialized orthopedic hospital.

At the end of the calls, the ambulance returns to the company's base, where all the occurrence data are archived and the material used is checked.

The experience of LUREEN students in partnering with the company's professionals allows the experience of real cases and how training and theoretical classes have applicability in practice. Thus, it is essential to socialize and exchange knowledge of the members of the league with nurses who work directly with first aid provided to patients, which contributes to the formation of the future nursing professional.

Coverage of cultural and sportive events.

The UFU's Nursing Emergency and Urgency League also monitors the coverage of cultural and sporting events that are held in Uberlandia. Such events, most often, consist of musical shows or any kind of cultural and sporting event that causes crowding of people.

The organization responsible for the events hires the service of the company that has similarity with LUREEN, enabling the contact of the students of the league with this type of duty. The professional team starts from the company's base to the event site before its start and remains in a strategic place, according to the availability of the site, to facilitate the displacement of the team and arrive at the service more quickly and efficiently.

Any type of occurrences related to urgency are attended, of which were witnessed: dressings of abrasions generated by falls during races, measurement of vital signs after physical exertion and care for a patient in anxiety crisis during a race. All attendances are recorded to control the use of materials and notification of cases, as well as in occurrences attended outside the events.

During one of the races, the team provided an ambulance at the place of arrival for any assistance to participants, and a quad bike equipped with first aid materials to accompany the athletes along the route. Depending on the situation, the quad bike removes the patient from the race to the ambulance, and from there he is referred to a hospital. The dressings performed in sports events according to the appropriate semiology and semi technique (POTTER et al., 2018).

Regarding the anxiety crisis, the patient was treated at the place where the call to the ambulance was made, showing signs of hyperventilation, high blood pressure, difficulty speaking and agitation. The anxiety crisis is defined as a form of psychic suffering, due to nervousness or behavioral factors that can be aggravated in situations that offer danger (ANDRADE, 2019).

Throughout this activity, the nursing academic was able to experience techniques and conducts that are useful in the profession. It was possible to observe how the shifts in the events are organized and how communication is made between the health team and the organization of the event, because it is essential for the public to have security during the event.

LUREEN continues to encourage league members to participate in these events, as it strengthens the partnership that is already consolidated, in addition to generating experiences that can be shared with other participants of the league. This reinforces the need to experience out-of-hospital practices to contribute to the education and knowledge of the academic.

Final Considerations

This study could describe some situations of urgency and emergency in health area in a student perspective. The outcomes presented in that experience report show a great way to improve and increasing learning of nursing students in undergraduate through an academic league as well as one of the best methodologies to provide real training in urgency and emergency situations. Moreover, health education has an important position about the responsibility of public universities and local community health assistance once scientific events and courses realized in LUREEN have potential do be applying in society. In that way, professional health's getting extra knowledge about urgency and emergency situations in undergraduate course are able to handle hard situations and decrease mortality rate in outside hospital context.

Furthermore, the LUREEN show evidences that just undergraduate disciplines in that field are not enough to develop all student skills so academics leagues can help that leaning process. It is expected that future studies approach similar issues to improve nurse education courses.

REFERENCES

- ANDRADE, F. M. S. Reorganizing care for patients with acute coronary syndrome in an emergency hospital. 2014. 24 f. TCC (Undergraduate) - Nursing Course, Federal University of Santa Catarina, Florianópolis, 2014.
- ANDRADE, J. V; et al. Anxiety: one of the problems of the 21st century. *Revista de Saúde ReAGES*, [S.l.], v. 2, n. 4, p. 34-39, Jul. 2019.
- ANZILIERO F; et al. Manchester System: time spent in risk classification and priority for care in an emergency. *Revista Gaúcha de Enfermagem*, v. 37, n. 4, 2016.
- Brazil. Ministry of Health. Mobile Emergency Care Service. Brasília, 2019.
- CESCAGE, CESCAGE. Journal for experience reports and articles of pedagogical and extension practices. Scientific journal professor in action. 2014.
- DANTAS, A.C.O; SANTOS, M. A; GOIS, M. B. T. C. Importance of the academic league for professional training: learning to work as a team. 2017.
- FERNANDES, M. T. C; NEUMAIER, C. A. Simulation as a methodology in the training of nursing students in the final stage of graduation. *Health Sciences Minutes* (ISSN 2448-3753), São Paulo, v. 7, p. 115, Jun. 2019.
- GALA, Shalin G.; CRANDALL, Marie L. Global Collaboration to Modernize Advanced Trauma Life Support Training. *Journal of surgical education*, v. 76, n. 2, p. 487-496, 2019.
- LEAL, D. T. B.; JUNIOR, E. C. The Expository Class in Accounting Teaching. *Accounting Vista & Magazine*, v. 17, n. 3, p. 91-113, 11 May 2009.
- MUSSELIN, Lidiane et al. Extension is action on health care: the influence on the professional training of graduate students. *Dialogos Magazine*, v. 23, n. 1, p. 7-19, 2020.
- NAEMT, NAEMT. PHTLS: Traumatized Pre-hospital Care. 8. Ed. Jones & Bartlett Learning, 2017.
- NASCIMENTO, B. B; et al. Difficulties in attending to psychiatric emergency situations and emergencies. *Mr. Arq. Mr. Cienc. Saúde UNIPAR*, Umuarama, v. 23, n. 3, p. 215-220, Sep./Dec. 2019.
- PEREIRA, J. M. B; MARQUES, C.M.P; CANELAS, M. P.P. The performance of nurses on basic life support. *Ibero-American Journal of Health and Aging*, [S.l.], v. 5, n. 1, p. 1760, Oct. 2019.

POTTER, P.A.; PERRY, A.G.; STOCKERT, P.; HALL, A. Nursing Fundamentals. 9^aed. Rio de Janeiro: Elsevier, 2018.

QUEIROZ, S. J; et al. The importance of academic leagues in professional training and health promotion. Culture fragments. v. 24, special, p. 73-78, 2014.

SANTOS, G. M; Et. al. Experience report: health education about first aid. Intercâmbio Magazine, Montes Claros, v. 3, p. 131-134, 2018.

SILVA, K. S; Et. al. Teamwork: reflections of managers of emergency and emergency services. Medical journal of Minas Gerais. v. 28, no. 5, 2014.

SOUSA, A. R; et al. Contributions of an academic trauma and emergency league to nursing education. Electronic journal management and health. v. 5, special, 2014.

Pressure ulcers: representation of life and death for wheelchair users

Bruna Henkel Ferro

Graduate Program in Cultural Diversity and Social Inclusion, Feevale University,
Rio Grande do Sul, Brazil.

Jacinta Sidegun Renner

Graduate Program in Cultural Diversity and Social Inclusion, Feevale University,
Rio Grande do Sul, Brazil.

Michele Barth

Graduate Program in Cultural Diversity and Social Inclusion, Feevale University,
Rio Grande do Sul, Brazil.

Eliane Fátima Manfio

Physical Education College, Feevale University,
Rio Grande do Sul, Brazil.

Geraldine Alves dos Santos

Graduate Program in Cultural Diversity and Social Inclusion, Feevale University,
Rio Grande do Sul, Brazil.

Abstract

Pressure ulcers can significantly affect the quality of life and social inclusion of wheelchair users, in addition to delaying the rehabilitation process and compromising the health-disease process. The aim of this study is to analyze the representation of pressure ulcers in the perception of life/death for wheelchair users. The methodological design of this research is applied, descriptive and participatory, with analysis and discussion of data under a qualitative paradigm. Seven collaborators who are wheelchair users of the Association of Spinal Cord Injuries in Rio Grande do Sul/Brazil (LEME) participated in the interviews. Data analysis was performed by using data categorization and triangulation. The results show the negative impact pressure ulcers have on users' health and social inclusion. The fear of appearance of pressure ulcers and the associated possibility of death, overlaps other situations that may result from the condition of being a wheelchair user. Users are aware that injuries associated with a bacterial infection can lead to death. The need for constant care and dressings, in addition to the body's own odor, become important limitations in social life. The importance of the prevention of pressure ulcers is emphasized as a way to promote social inclusion and physical and emotional well-being of users.

Keywords: pressure ulcers; fear; death; wheelchair users.

1. Introduction

In terms of contextualizing the theme of this research, the World Report on Disability, states that more than one billion people worldwide live with some type of disability, that is, about 15% of the world population, among which about 200 million experience considerable functional difficulties [1]. According to Kang et al. [2], worldwide, the incidence of spinal cord injuries varies between 13.0 per million to 163.4 per million people, the majority being male. In the coming years, the incidence of disability will continue to increase due to the aging of populations and the greater risk of occurrence in the older population, including the global increase of chronic diseases. For people with spinal cord injuries and other people with reduced mobility, the use of a wheelchair is essential for mobility. It assists the participation of people with disabilities in numerous activities and it provides greater independence both at home and in the community [3].

The wheelchair plays an important role for the social inclusion of wheelchair users, as it allows the right to independence and to move in the social space, being a part or extension of their body. It also makes possible the manifestation of the corporeality of the person with physical disabilities. It is through the wheelchair that users feel and use the body as a tool for interacting with society, thus allowing their insertion in the socio-cultural context [4]. When it comes to wheelchair users, they spend most of the day in a sitting position, which makes the seat an extremely important structure for the users' comfort.

In the sitting position, the body comes into contact with the seat through the ischial tuberosities that are composed of two rounded bones that resemble an inverted pyramid [5]. As a result, most of the total body weight is supported on these tuberosities, causing this load to be distributed over a relatively small area, thus creating great pressure efforts. To relieve this pressure, people change their posture periodically. However, wheelchair users, in most cases, do not have this feature of postural change, nor the sensitivity to feel the pressure produced by the body, which is translated by discomfort. The localized pressure on the skin tends to compromise the circulatory system in the affected body region and, when combined with factors such as humidity, heat and friction, it can result in a pressure injury in a short period of time. The National Pressure Ulcer Advisory Panel (NPUAP) defines pressure ulcers as localized damage to the underlying skin and/or soft tissues. It usually occurs on a bony prominences or related to the use of a medical device or other artifact. The lesion can appear on intact skin or as an open ulcer and can be painful [6]. Users who have no preserved and/or altered sensitivity have no perception of pain or awareness of the deterioration of their skin.

In order to contextualize the severity and impairment of pressure ulcers in the health and social life of wheelchair users, Candido [7] comments that depending on the degree of the skin lesion, the healing time may be high, in some cases reaching up to 20 years with an open ulcer. During the healing period, pressure at the site should be restricted, and the user should avoid sitting. Pressure ulcers are listed as a direct cause of death in 7-8% of all patients with paraplegia in the United States [8]. Prevention is the best treatment as pressure ulcers can significantly affect the quality of life of users and delay the rehabilitation process, thus leading to social and economic commitments from their families.

When discussing the severity of pressure ulcers, it is essential to mention that pressure ulcers tend to be the predominant factor for the condition of social exclusion, as well as causing a recurrent and constant

fear of death. Is important to emphasize that there are exclusionary social processes, but there are no consummated, definitive and irremediable exclusions. Exclusion is a sociological category, not the way of referring to someone, as it is the phenomenon that is excluding and not the subject that is excluded.

From this context, the general objective of this study was to analyze the representation of pressure ulcers in the perception of life/death of wheelchair users.

2. Material and Method

From the point of view of its nature, this research is an applied research. In regard to its objectives, it is a descriptive research, and considering its procedures, it is a field and participatory research. The problem is approached through the qualitative paradigm [9].

The sample was constituted in a non-probabilistic way for convenience. The collections were carried out at the Association of Spinal Cord Injuries in Rio Grande do Sul (LEME), in the city of Novo Hamburgo, Brazil. LEME is a philanthropic civil association that provides assistance to people with spinal and physical disabilities.

All participants signed an informed consent form (ICF) prior to being interviewed, so that they were aware of their contribution in the study and granted permission for the use of the information collected. Authorization was also requested so that the interviews could be recorded. During the interviews, seven participants exposed their experiences, opinions and fears about the appearance of pressure ulcers after spinal cord injury.

As for the data collection instruments, participant observation was carried out from the weekly contact for two years with the LEME members, in addition to the observations recorded in the field diary. According to Minayo [10], participant observation is essential in a qualitative research, as researchers place themselves in direct relationship with interlocutors, participating in social life to obtain data and understand the research context. The analysis was carried out by using data categorization and triangulation as suggested by Minayo [10].

3. Results

Table 1 presents the data of the general profile of the participants in this research. Pressure ulcers had already affected 5 out of the 7 participants, and the healing time of the injuries ranged from 2 months to 4 years. The type of motor deficit of all employees is paraplegia. Except for participant 3, the others acquired spinal cord injury due to an accident, which ended up compromising motor control and sensitivity in the lower limbs. It is important to highlight that the lack of sensitivity combined with reduced mobility increases the risk of developing pressure ulcers.

Table 1. Characteristics of study participants

Collaborator	Gender	Age (years)	Time wheelchair (years)	Reason	Pressure injury	Injury location
1	Male	28	16	Car accident	Yes	Buttocks
2	Female	62	12	Falling window	Yes	Buttocks and feet
3	Female	35	08	Virus in the marrow	No	-
4	Male	62	23	Falling Tree	Yes	Buttocks
5	Male	27	04	Car accident	No	-
6	Male	43	08	Fire gun	Yes	Buttocks and toe
7	Male	33	06	Motorcycle accident	Yes	Feet and heels

Based on the analysis of the interviews, the results were grouped into two categories according to the classification and the grouping of elements in common, which are: a) fear of the appearance of pressure ulcers; b) fear of death. The triangulation was then carried out, based on three aspects that led to the analysis: the empirical data collected in the research, the dialogue with the authors who study the issue and the analysis of the situation [11].

3.1 Fear of the Appearance of Injuries

The interviews revealed that the participants are very afraid of the appearance of pressure ulcers, including the two individuals who have never had, and those who have already had the injuries. Participant 1, who has already suffered a pressure injury, refers to his fear as follows: “It is a villain, I don't like it. I am not afraid of the dark, I am not afraid of lightning, but I am afraid of it. I run away from it. It is to stop life”. This report is extremely relevant in the sense of the representation of pressure ulcers as limiting in all senses, causing fear. According to Bauman [12], the feeling of helplessness is the most frightening impact of fear, and “‘fear’ is the name we give to our uncertainty, to our *ignorance* of what the threat is and our incapacity to determine what can and can not be *done* to counter it, if ceasing it is beyond our reach” (p. 5).

In the daily lives of the participants, the fear of being affected by the injury and the feeling of helplessness in the face of their involvement is constantly manifested. This situation appears in the speech of collaborator 1 when he mentions that he is not afraid of many situations (which are usually fearful for some people), but that he is afraid of injuries and that he runs away from them, so that they do not “stop his life”.

Participant 2 reports her experience in the period when she had the open wound and in the process of healing:

I am very afraid, the way I got, I do not wish for anyone, it is very sad. I had to stand sideways, it leaked and leaked. I have never seen anything like that. It's awful. When they removed all those spoiled meats, then I would not sit for days, and it would bleed, horrible.

This narrative, in which participant 2 comments on the “spoiled meats” that doctors had to remove from her body, reports the loss of parts of her body that no longer serve. It is important to note that the fact of presenting an open and exposed wound on the body is extremely dangerous, as it is a gateway for bacteria. According to Linder-Ganz et al. [13], about 80% of wheelchair users have already had injuries, usually in the coccyx region and ischial tuberosities, and 8% of these have developed *sepsis* (infection by bacteria). In this sense, participant 3, who never had pressure ulcers, exposed the following:

Imagine you having that in your body, wow, I can't imagine it, I can't imagine the discomfort it must be. [...] you have to be very careful, the bacteria, anything that goes in there, must be terrible, I can't even imagine. And if you are not sensitive, you will always hurt, and it will hurt, hurt, and it will open more, it will open more. You can't do anything, it interrupts you, it disrupts everything.

The last sentence of this narrative is quite significant, as the participant considers the pressure ulcer as an affection that tends to interrupt life, changing not only the health aspect, but alternating the flow and sequence of life. It is noteworthy the fact that the employee has never been affected by pressure ulcers, however, the feeling of apprehension when she says that “it must be terrible, I can't even imagine it”, expresses the fear and understanding of the danger and consequences that an injury can result. In this sense, Bauman [12] says that the dangers that cause fear fall into three categories. Some threaten the body and property. Others are of a more general nature, threatening the durability of the social order and the reliability in it, on which the security of livelihood depends on income and/or employment, or even survival in the case of disability (or old age). Then, the dangers that threaten the people's place in the world surface, namely, the position in the social hierarchy, identity and, more generally, immunity from degradation and social exclusion.

The presence of pressure ulcers affects, in a certain way, the three types of dangers and fears mentioned by Bauman [12]. The injury directly threatens the body of the affected subjects. It interferes with the security of sustenance, because with the injuries on their body, individuals are temporarily or indefinitely away from work and social space - when they are no longer away from work due to disability due to spinal cord injury. Consequently, the injury threatens the individuals' place in the world when it puts their social inclusion at risk.

Still on fear and its effects and influences on daily life, Bauman [12] states that:

The opportunities to be afraid are among the few things that are not lacking in our age, which is highly lacking in matters of certainty, security and protection. Fears are many and varied. People of different social, age and gender categories are plagued by their own fears; there are also those we all share - whatever part of the planet we may have been born in or have chosen (or been forced to choose) to live in (p. 23).

The fear reported not only by employees who have already had injuries, but also by those who have

never had injuries, clearly demonstrates the feeling of being susceptible to danger and the feeling of insecurity and vulnerability that the 'derived fear' implies. The author explains that this derived fear is a constant mental system that can be described as the feeling of being susceptible to danger; a sense of insecurity (since the world is full of dangers that can collapse on us at any second with some or no warning) and vulnerability (if the danger materializes, there will be little or no chance of escape and/or defense successfully). Still, a person who has repressed and internalized “a worldview that includes insecurity and vulnerability will routinely resort, even in the absence of a genuine threat, to appropriate reactions to an immediate encounter with danger; “derived fear” acquires the capacity for self-propulsion” (p. 6) [12].

When discussing the fear of being affected by injuries, it becomes relevant to contextualize the relationship between fear and the interference factors in the occurrence of the injury and the reasons that make it so feared. In this sense, one of the biggest problems that are limiting in terms of health and quality of life is the prolonged period of treatment for the healing of injuries, which leads to the removal of the individual from living in society. In addition to the fact that they are dependent on the help of other people, reducing their autonomy and the freedom to come and go. Costa et al. [14] state that in addition to the time for healing of the wounds, conservative treatment tends to be long (including periods of morbidity due to mild trauma with skin breakdown). In contrast, the time to develop an injury can vary between 24 hours up to 5 days. Therefore, it is extremely important that wheelchair users have access to information regarding preventive approaches to pressure ulcers.

When it comes to approaches and care for bedridden people with reduced mobility, which is the case for wheelchair users, most caregivers and people affected, are aware that the development of pressure ulcers is a consequence that must be avoided. Ota [8] states that approaches focused on prevention can be less costly than approaches focused on treatment, and prevention can decrease the incidence by at least 50%, which makes the situation less difficult, both economically and in relation to the suffering caused. As a means of prevention, the author suggests repositioning the individual every 30 minutes to alternate the distribution of body weight. Pressure redistribution, especially on bony prominences, is a major concern when it comes to prevention. Every effort should be made to redistribute pressure on the skin by repositioning it every two hours and using pressure redistribution surfaces [15].

In the interviewees' narratives, few statements refer to preventive strategies. However, based on the perceptions transcribed in the field diary and participant observation, it is evident that preventive actions occur. The movement of suspension of the body from the wheelchairs is frequently observed. This movement represents a quick and small pressure relief, as the wheelchair user suspends the body with the strength of their arms for a few seconds, relieving the discomfort of the pressure (although they have little sensitivity or almost none). The purpose of suspension and/or repositioning is to redistribute, alternate and relieve pressure on susceptible areas, and consequently, maintain circulation in areas of the body at risk of developing injury. In the case of bedridden or wheelchair users, pillows and cushions are easily available materials that can be used to assist in redistributing pressure. When used properly, they can expand the surface that supports body weight. Generally, the skin of spinal cord injured persons at risk for pressure injury breaks easily during repositioning. Therefore, care should be taken with friction during this procedure [15]. The NPUAP also suggests additional prevention alternatives, such as humidity control, maintenance of the user with dry and hydrated skin. Moist skin is more vulnerable, facilitates the

development of skin lesions, and tends to break more easily. The skin must be clean, whenever it is dirty and at regular intervals [6].

Rabeh, Caliri and Haas [16] emphasize that the frequency of the development of injuries interferes with physical, psychological and social conditions, causing a negative impact on the quality of life of users. When it comes to quality of life, the minimum and universal material level to discuss about, refers to the most basic needs of human life, and among them is health, leisure, education, work, food, in addition to relative notions of comfort, well-being, personal and collective fulfillment [17]. In addition, the WHO [18] also mentions the physical and psychological state, level of independence, social relationships, and the individuals' relationship with the environment. With pressure ulcers, all aspects mentioned related to quality of life are affected, and, consequently, have a negative impact on the social inclusion of wheelchair users.

3.2 Fear of Death

The speech of most participants was related to the awareness of the risk of death due to pressure ulcers. In this sense, participant 4 explains that: "In life, it is a crucial problem. It has to be treated as a priority, it can lead to death". Rodrigues [19] comments that the awareness of death is a mark of humanity, because humanity is the only species to be truly aware of its own finitude, and this awareness "opens a passage through which remarkable forces will pass that will transform the human way of seeing life, death, the world" (p. 19).

Participant 5 report: "You don't die from a gunshot, you don't die from an accident, but you die from the wound". This statement is very significant and is in line with the reports of all employees, who are aware of the possibility of death due to injuries. That is, the primary cause of spinal cord injury tends not to be the predictive factor for death, but rather, the resulting factors and associated comorbidities, in this case, pressure injury. We can relate this narrative of participant 5 with the "death-events" that Rodrigues [19] presents, in which death-events mean different things according to the themes they occupy and according to the particular condition of death to which they belong.

Rodrigues [19] states that all cultures in principle insert death into a system of classifications to understand death-events, to dialogue with them and to attribute some meaning to them. He cites examples in Brazil, in which a person can die of natural causes, or of old age, or of external sources, and still of violent death, each of which causes a particular emotional reaction in the surviving people.

Dying of natural causes' means that it is not necessary to look for a culprit and that the individual has reached the end of biological existence for reasons linked to the very functioning of the organism, without a particular disease being held responsible. In this case, if the cause exists, it is always pointed out: 'died of a heart attack', 'knot-in-the-guts', 'weakness', 'heartbreak'. Dying of 'old age' is perhaps the most typical occurrence of 'natural cause death'. It is the death of the elder, who slowly approaches the end - because all terrestrial existence is finite - without involving accidents, aggressions or other changes in the normal process of life. Death 'by natural causes' and of 'old age' perhaps confirms what traditional Brazilian culture calls 'natural death' [...]. At the other extreme, we find the 'external sources' death, a category that includes all death events for which a responsible person could be pointed out: by accident, murder, suicide [...]. For a Brazilian, this system of

classification of death-event is fundamental: when faced with the news that someone has died, people will ask immediately, without much thought – died of what? (p. 26) [19].

Unfortunately, in the universe of wheelchair users and/or spinal cord injured people, dying of “death by wound” (a term that is often used by them to designate pressure ulcers) is an imminent reality, because the cause of death is constantly due to some complication of direct or indirect reason to pressure ulcers. This fact is known to participants, because through the narratives it is clearly noted that they address the risk of infection by bacteria as a factor that may lead them to death because of the injury, as previously mentioned. Participant 6 reports:

It is a disease that ends up killing you, it kills and it doesn't kill lightly, it kills you little by little, because it will eat you from inside out. The wound corrodes and corrodes all the person's flesh. It stays there, the skull. You stink, it's cruel. You don't want to eat, you don't want to drink water, nothing, because of that carrion, the guy feels it. You move a little and you already feel that stench”.

Participant 6 relates this stench to the scent of carrion, including reporting a feeling of shame due to the odor exhaled by his body. For this reason, he often ends up not leaving his home and avoids moving his body too much so as not to smell it. The relationship that this employee makes of the body that corrodes inside, which gradually deteriorates and spoils with the wounds, is very sad, and can be directly related to the slow death of parts of his body. This leads us to infer, from these narratives, that these wounds are the representation of the death of the perfect body and the birth of a vulnerable and deteriorating body. Vicensi [20] states that “the terminality of life is a fact, and the process of dying, especially when it happens due to illness, accident or any situation that causes physical pain and suffering, requires that all involved people have awareness and wisdom to face it” (p. 71).

When we go back in time and study ancient cultures and peoples, we have the impression that man has always abhorred death and will probably always repel it. From a psychiatric point of view, this is quite understandable and perhaps best explained by the basic notion that, in our unconscious, death is never possible when it comes to ourselves. It is inconceivable for the unconscious to imagine a real end to our life on earth and, if life has an end, it will always be attributed to an evil intervention beyond our reach [...]. Therefore, death itself is linked to a bad action, a ghastly event. (p.14) [21].

Vicensi [20] states that death and the process of dying is part of the phenomenon of life, “although it arouses fear in human beings, justified by the difficulty in dealing with their own finitude. It can be characterized as an event inherent to life, because, in a way, one is gradually dying at all times” (p. 65). The fear of dying due to pressure ulcers reported by most participants may be related to the fact that, in surviving, they had “a second chance”. In the interviews, many mention God as a superior force, including thanking Him for being alive and giving them a second chance.

Bauman [12] states that fear is inherent in every living creature and links this experience of fear

that human beings feel with the fear that animals feel, in which reactions to the immediate presence of a threat that puts their lives at risk (both of animals and humans), oscillate between attempts to escape and aggression. However, human beings know something more than that, which would be, according to the author, a “secondary fear”, which can be present both in a situation of immediate threat or not. And this fear “can be seen as a trace of a past experience of facing the direct threat - a remnant that survives the encounter and becomes an important factor in shaping human conduct even though there is no longer a direct threat to life or integrity ” (p. 5) [12]. It is believed that there is a double fear of death in which, in addition to being close to death at the time of the accident, wheelchair users end up again facing the risk of dying due to pressure ulcers.

In the fact of the death of some known person or the death of some unknown person, Rodrigues [19] report the idea that the death of the other “is the announcement and the prefiguration of death in 'itself'” is emphasized. It mutilates a community, breaks the normal course of things, questions the moral foundations of society, threatens the cohesion and solidarity of a group that is wounded in its integrity” (p. 82). Participant 7 comments: “I already lost a friend of mine because of these ulcers, he died due to the wound”. It is noteworthy that during the period of insertion in the field of study for data collection, many participants reported knowing someone who died due to pressure ulcers, including mentioning two LEME users who died close to the period of completion of the study. Rodrigues [19] states that death is not just the destruction of a physical and biological state from a human point of view. It is also the death of a person who is social, of a person who interacts. And the emptiness of death is felt first as an interactional emptiness that affects not only close people, “but the whole of the social scope in its very principle, the image of society printed on a corporeality whose action - dancing, walking, laughing, crying, speak ... - does nothing more than expressing itself” (p. 20). One would hardly find any wheelchair user and/or spinal cord injured person who does not know or has heard of someone who died as a result of pressure ulcers.

Regarding human finitude, Rodrigues [20] claims that physical death is not enough to achieve death in consciousness. For the memories of a person who died recently, remain a way of their presence in the world. And this presence is slowly succumbing through a series of lacerations by the survivors who remain here. Death is the only absolute certainty in charge of life, it is a final event, the fact of which cannot be denied. And the death of the other will always evoke one's ‘own death’, it will force you to think about your own limits and will confirm the fragility of the human being in the face of life.

4. Conclusion

Based on the results of this research, it was possible to verify the negative impact of pressure ulcers on health and on the social inclusion of wheelchair users. The constant presence of the fear of being affected by pressure ulcers and the possibility of death overlaps with any other situation that may result from their condition as wheelchair users.

Users are aware that the incidence of pressure ulcers associated with a bacterial infection could lead to death. The malaise felt by the need for care and dressings and exposure of the body that is mentioned as “fetid” turns out to be an important limiter of social life. In addition, pressure ulcers are addictive, delay the rehabilitation process of the primary injury, and lead to impairments in social and family life and

relationships and living with people.

Finally, the importance of preventing pressure ulcers is emphasized as a way to promote and maintain social inclusion and the physical and emotional well being of those who are conditioned to live in a wheelchair. In this case, may the coexistence be as harmonious as possible.

5. References

- [1] World Health Organization. World report on disability. WHO, Geneva, 2012.
- [2] Kang, Y., Ding, H., Hengxing, Z., Wei, Z., Liu, L., Pan, D., and Feng, S. Epidemiology of worldwide spinal cord injury: a literature review. *Journal of Neurorestoratology*, 6, p.1-9, 2018.
- [3] Chaves, E. A., Boninger, M. L., Cooper, R., Fitzgerald, S. G., Gray, D. B., and Cooper, R. A. Assessing the influence of wheelchair technology on perception of participation in spinal Cord injury. *Arch Phys Med Rehabil.*, 85, 2004.
- [4] Ferro, B. H. Design ergonômico como ferramenta para a inclusão social: o caso dos usuários cadeirantes. 2017. 214 f. Master dissertation (Master in Cultural Diversity and Social Inclusion. Feevale University, Novo Hamburgo-RS, 2017.
- [5] Iida, I., and Guimarães, L. B. M. Ergonomia: projeto e produção. São Paulo, SP: Edgard Blücher, 2016. 850 p.
- [6] SOBEST. Classificação das Lesões por Pressão. Consenso NPUAP 2016. Culturally Adapted for Brazil. Available in: <http://www.sobest.org.br/textod/35>.
- [7] Candido, L. C. Nova abordagem no tratamento de feridas. São Paulo, SP: SENAC São Paulo, 2001. 282 p.
- [8] Ota, A. S. Prevenção das Úlceras de Pressão. 2008. 25 f. Monography (Graduate Program in Applications Complementary to Military Sciences). Escola de Saúde do Exército Rio de Janeiro, Rio de Janeiro, RJ, 2008. Available in: http://www.essex.ensino.eb.br/doc/PDF/PCC_2008_CFO_PDF/CD13%201%BA%20Ten%20Al%20AN A%20SAYURI%20OTA.pdf.
- [9] Prodanov, C. C., and Freitas, E. C. Metodologia do trabalho científico: métodos e técnicas da pesquisa e do trabalho acadêmico. Novo Hamburgo, RS: Feevale, 2013. 277 p.
- [10] Minayo, M. C. S. O desafio do conhecimento: pesquisa qualitativa em saúde. São Paulo, SP: Hucitec, 2014.
- [11] Marcondes, N. A. V., and Brisola, E. M. A. Análise por triangulação de métodos: um referencial para pesquisas qualitativas. *Revista Univap*, 20(35), 2014.
- [12] Bauman, Z. Medo líquido. 2008. Available in: <https://integrada.minhabiblioteca.com.br/#/books/9788537808542/cfi/6/2!/4/2/2@0:0.0988>.
- [13] Linder-Ganz, E., Scheinowitz, M., Yizhar, Z., Margulies, S.S., and Gefen, A. How do normals move during prolonged wheelchair-sitting? *Technol Health Care*, 15, 195-202, 2007.
- [14] Costa, V. S. P., Melo, M. R. A. C., Garanhani, M. L., and Fujisawa, F. S. Representações sociais da cadeira de rodas para a pessoa com lesão da medula espinhal. *Rev. Latino-Am. Enfermagem*, 18(4), jul-ago 2005.

- [15] Brasil. Ministério da Saúde; Agência Nacional de Vigilância Sanitária. Anexo 02: Protocolo para prevenção de úlcera por pressão, 2013. Available in:
<http://portal.anvisa.gov.br/documents/33852/271855/Nota+T%C3%A9cnica+GVIMS-GGTES+n%C2%BA+03-2017/54ec39f6-84e0-4cdb-a241-31491ac6e03e>.
- [16] Rabeh, S. A. N., Caliri, M. H. L., and Haas, V. J. Prevalência de úlcera por pressão em indivíduos com lesão da medula espinhal e a relação com a capacidade funcional pós trauma. *Acta Fisiatra*, 16(4):173-178, 2009.
- [17] Minayo, M. C. S., Hartz, Z.M.A., and Buss, P. M. Qualidade de vida e saúde: um debate necessário. *Ciência & Saúde Coletiva*, Rio de Janeiro, 5(1): 7-18, 2000.
- [18] OMS. Health promotion: gloss. Geneva: OMS, 1998.
- [19] Rodrigues, J. C. Tabu da morte. Rio de Janeiro: Editora FIOCRUZ, 2006. 260 p.
- [20] Vicensi, M. C. Reflexão sobre a morte e o morrer na UTI: a perspectiva do profissional. *Rev. Bioét.*, Brasília, 24(1): 64-72, 2016. Available in:
http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1983-80422016000100064&lng=pt&nrm=iso.
- [21] Kübler-Ross, E. Sobre a morte e o morrer: O que os doentes terminais tem para ensinar a médicos, enfermeiras, religiosos e aos seus próprios parentes. São Paulo: Martins Fontes, 1996. 299 p.

Student Demographic Factors on Perception of The Influence of Guidance and Counselling and School Adjustment in Keiyo North Sub-County, Kenya.

Wilson Kiptala (wilkiptala@gmail.com) Moi University (Educational Psychology Department), John **Kipruto** (johnkipruto@gmail.com) Moi University (Educational Psychology Department) and Evelyn **Kanus** (ekanus@ymail.com) Turkana University (Educational Psychology)

Abstract

The purpose of the study was to investigate student demographic factors on perception of the influence of guidance and counseling and school adjustment in Keiyo North Sub-County, Kenya. The objectives of the study were: to determine gender type and students' perceptions on the influence of guidance and counselling on school adjustment, school type and students' perceptions on the influence of guidance and counselling on school adjustment and class level and students' perceptions on the influence of guidance and counselling services on their overall school adjustment. The study was guided by the self-perception theory. The ontology was pragmatism and the epistemology was realism. The research method was mixed method. The research design was ex post-facto, random sampling and stratified techniques were applied. A sample of 21 schools and 367 out of the 8001 students in the sub-county secondary schools were selected. A further, 16 participants were purposively selected (one from each class level of the type of school). Questionnaires and interview guides were used to collect data. Descriptive and inferential statistics were used to analyze the quantitative data. The hypotheses were tested at a significance level of 0.05. The qualitative data was analyzed thematically. The major finding of the study was that female students had a higher mean perception (3.6391, SD .06308) than the male students (3.4000 SD .07159). The study concluded that consistency and competence in provision of guidance and counselling services is wanting in secondary schools in the sub-county. Based on the findings of the study, it was recommended that since there exists' significant differences in demographic factors on students' perceptions on the influence of guidance and counselling on their school adjustment, there was need to address the challenges and shortcomings that exist in the provision of guidance and counselling, and encourage the male students to participate in guidance and counselling activities.

Key Words: students, demographic factors, perception, guidance and counseling, school adjustment

Introduction

The emotional and psychological status of many learners in both primary and secondary school levels in the 21st century has been vastly affected by various aspects including substance abuse, poverty, teenage pregnancy, domestic violence, among other factors (Nasilumbi, Jenniffer & Prisca, 2016). Furthermore, the

government of Kenya through the Ministry of Education banned corporal punishment in schools through legal notice, No 95 of the Kenya Gazette (Government of Kenya (GOK), 2001). Besides, a study conducted by Ocharo and Oduol (2009) observed that in the year 2001 a record of 250 Schools went on strike in Kenya and in 2008 in the months of July and August approximately 300 secondary schools went on rampage. Moreover, investigations by a parliamentary committee set to investigate the matter reported that several causes contributed to the strikes; among them was lack of an effective guidance and counselling system in schools (Ocharo & Odoul, 2009). In addition, (Nasilumbi, Jenniffer & Prisca, 2016; Lutomia & Sikolia, 2008)) posit that G & C programmes and services are not well coordinated in most schools. Besides, guidance and counselling is viewed as being concerned with the holistic growth and adjustment of an individual to the environment with special regard to the dignity and self-esteem of the individual (Basci & Dilekmen, 2009; Gitonga, 2007a; Gitonga, 2007b; KIE and LISP, 2003).

Research undertaken by social psychologists reveal that attitude influence behavior and similarly behavior influence attitude (Baron & Byrne, 2003; Feldman; 2002). Furthermore, over the years, students' perception of school counselling and their attitudes to its programmes has increasingly generated a great deal of concern among school counsellors in many parts of the world (Corney et al; Glazer, & Harman, in Comfort (2014)). Moreover, the effectiveness of any counselling service has been attributed largely to the prevailing climate of opinion towards such a service (Comfort, 2014). Additionally, Counselees attitudes which reflect this opinion are indices of their willingness or otherwise to accept, patronise or utilise counselling services. Evidence from related literature reveals two basic attitudinal response patterns, those students whose attitudes are positive (Burke, in Comfort (2014)) and those whose attitudes are negative (Mack & Mclover, in Comfort (2014)). Burke and Bryan in Comfort (2014) aver that if the perception of counselling is low or poor it is likely to elicit negative attitudinal response and result in a rejection of its programmes. The opposite holds if their perception is high or good.

Research has well established the indispensable role that guidance and counselling services play in the life of students (Comfort, 2014). Additionally, one of the roles is to improve the mental health and reduce psychological disturbances (Egan, 2002; McGuiness, 1998). Chireshe (2011), shares the same opinion in making the claim that guidance and counselling services impart students with life skills, attitudes and values that enable them to solve problems and make sound decisions thereby helping students address the social, psychological and emotional problems they experience. He further claims that that guidance and counselling services received by students result in a decrease in cases of poor discipline among students and reduced dropout rates. Moreover, in a study carried out in Haramaya University in Ethiopia showed that about 42 % of the participants acknowledged that guidance and counselling services are always helpful in minimizing or alleviating students' academic, vocational, social and personal problems (Seyoum, 2011).

Mutie and Ndambuki (2004) emphasize the need to introduce and strengthen the guidance and counselling services in schools and colleges so as to meet the varied needs of students. Furthermore, Nondo (2004) posits that some students engage in antisocial behaviour such as drug and alcohol abuse and irresponsible sexual behaviour. Consequently, this is seen to result from lack of knowledge on how to manage leisure time on the part of the students and it has led to a decline in moral integrity. Additionally, the need for guidance and counselling services could also be due to the ever-growing complexity of the society and the

people have to learn how to cope with accompanying challenges (Biswalo, 1996). Moreover, it should be noted that despite the many benefits of guidance and counselling services, studies that have investigated the secondary school students' perceptions of the influence of guidance and counselling services on their school adjustment have been inconclusive.

Research shows that secondary schools in Kenya have established guidance and counselling departments (Ndirangu, 2007). Moreover, this could possibly be because of the stringent measures that have been put in place by the Quality Assurance Officers from the Ministry of Education, Science and Technology (MOEST). However, the guidance and counselling services face a number of challenges. A research by Auni, Songok, Odhiambo and Lyanda (2014) posits that the poor social adjustment in schools was as a result of the challenges faced by the guidance and counselling departments. Additionally, they observed that majority of the heads of department do not have adequate training that would help them to handle the varied issues affecting students in schools since the short term workshops and seminars that the majority of them had attended were not sufficient in empowering them to effectively guide and counsel students. Moreover, the guidance and counselling teachers also had other responsibilities in schools with heavy subject loads and therefore not able to run the programme well. Besides, the same study also reported that some students had a poor attitude towards the programme and were not willing to confide in teachers doubling up in the guidance and counselling activities and being a member of the disciplinary committee.

A study conducted in Gwinnet County, Georgia, showed that school counselling has an impact on academic performance, and increase the on-task, productive behaviours. Additionally, the Behaviour Rating Checklist indicated statistically significant increases in productive on-task behaviour for both third grade and fifth grade students tested. Furthermore, Language Arts progress was statistically different for both levels as well (Mullis & Otwell, 2007; Watts & Thomas, 1997). According to a study conducted by Ng'eno (2012) on teachers' and students' perception on the impact guidance and counselling on students' needs in Rift Valley province posits that there is a significant class level difference in perception. Moreover, Chireshe (2011) reported that students from Form 4 to 6 viewed guidance and counselling services more negatively than those from other forms. Furthermore, in a study to survey counselling needs among technical college students in Ebonyi State, Nigeria, Nweze and Ugochukwu (2014) there were significant differences in college adjustment in terms of class level on academic achievement. However, boys tended to experience more social relationship problems than girls hence their counselling needs were more.

Overwhelming scientific evidence highlight the multiple benefits of guidance and counselling services in students' lives and subsequent school adjustment (Biswalo, 1996; Egan, 2002; McGuinness, 1998; Seyoum, 2011; UNESCO, 2000a; Wentzel, 2003). Additionally, due to this realization, guidance and counselling services have been set up in virtually all schools in Kenya as a matter of government policy (Ndirangu, 2007). Moreover, research and reports however, show that cases of indiscipline in Kenyan secondary schools are quite prevalent and on the rise. Besides, indiscipline in schools takes various forms. These forms include alcohol and drug abuse, (National Authority for the Campaign Against Alcohol and Drug

Abuse (NACADA), 2011; Ngesu, Ndiku & Masese, 2008), teenage pregnancy (Republic of Kenya, 2010), cheating in national examinations whereby in the year 2013, examination irregularities were reported in Kenya Certificate of Secondary Examination (KCSE) (Aduda, 2014). Furthermore, drug and alcohol abuse seems to be the most common form of indiscipline as shown in a recent survey in Kenyan secondary schools reported by Kibet (2014). It should be noted that despite the manifold benefits of guidance and counselling services, very few studies have investigated student demographic factors on perception of the influence of guidance and counselling and school adjustment in Kenya.

Objectives of the study

The purpose of the study was to investigate student demographic factors on perception of the influence of guidance and counselling and school adjustment in Keiyo North Sub-County, Kenya.

The objectives of the study were to:

1. Determine gender type and students' perceptions on the influence of guidance and counseling on school adjustment
2. Investigate school type and students' perceptions on the influence of guidance and counseling on school adjustment
3. Examine class level and students' perceptions on the influence of guidance and counseling services on their overall school adjustment.

Method

Participants

To answer the research questions, the author sought views from the students on their perceptions on the influence of guidance and counselling services. A sample of 21 schools and 367 out of the 8001 students in the sub-county secondary schools were selected. A further, 16 participants were purposively selected (one from each class level of the type of school). Questionnaires and interview guides were used to collect data.

Measures and procedure(s).

Data was generated using semi-structured interviews and questionnaires from students. Although semi-structured interviews rely on pre-formulated questions for guidance, they also allow respondents to talk freely about those things that are of interest and importance to them (Baker & Foy, 2008). Moreover, they allow the researcher to probe the informants deeper by asking more questions not included in the guide. Consequently, the guide will not limit the interviewees on informing their perceptions, experiences and knowledge of guidance and counselling (Cohen *et al.*, 2011). The researcher also generated data using questionnaires as per the themes espoused by the study. The students were selected conveniently with at least one from each class level of the type of school.

Data was analyzed quantitatively (using descriptive statistics) and qualitatively (thematically). According to O' Donoghue and Punch (2003), triangulation is a method of crosschecking data from multiple sources to search for regularities in the research data. The main purpose of triangulation is to obtain complementary quantitative and qualitative data on the same topic, bringing together the different strengths of the two

methods. It increases the credibility and validity of the results. Triangulation typically involves the concurrent but separate collection and analysis of two types of data which are then merged at some stage (Creswell & Plano Clark, 2007).

Results

Gender of the participants

The study sought to determine gender type and students' perceptions on the influence of guidance and counselling on school adjustment, in Keiyo North Sub-County, Kenya. Interviews and questionnaires were used to find out the gender of participants who participated in the study. The findings were summarized and presented in Figure 1 below.

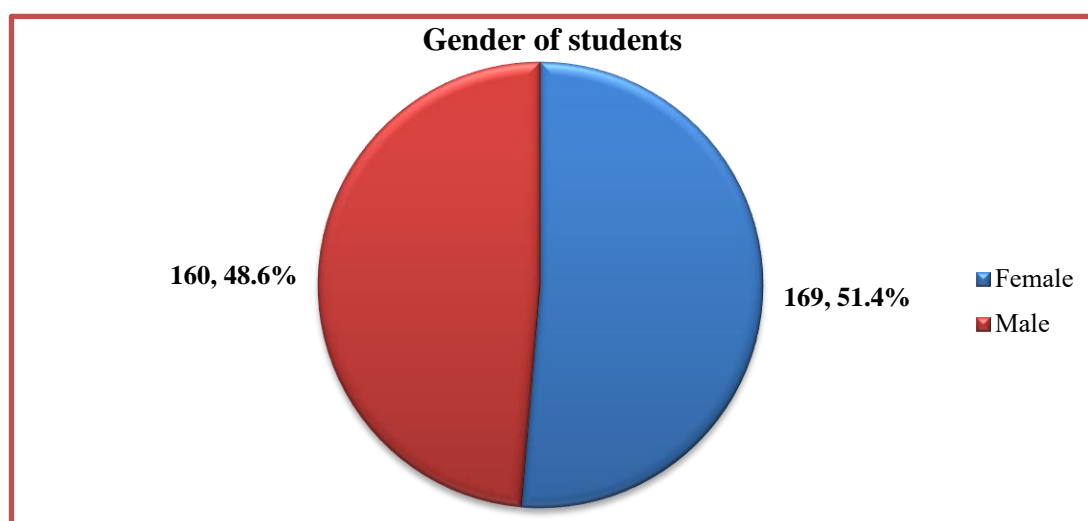


Figure 1: Gender of Students

Findings show that 169 (51.4%) of participants were female while 160 (48.6%) were male. This ensured a balance in responses among male and female participants. This was helpful in determining the students' perceptions on the influence of guidance and counselling services on their school adjustment in relation of gender in Keiyo North Sub-County.

Gender Ratings of guidance and counselling

The findings in table 1 below shows that more girls than boys in Keiyo North Sub-County tend to rate guidance and counselling services as good. The implication of these findings is that girls' schools may have improved or better services' provision as compared to boys' schools.

Table 1: Description of Gender and Ratings of Services

Gender N	Ratings			
	Poor	Average	Good	
Female	19 (11.2%)	63 (37.2%)	87 (51.4%)	169
Male	66 (41.3%)	46 (28.7%)	48 (30%)	160
Total	85 (25.8%)	109 (33.1%)	135 (41.0%)	329

Gender and Influence of guidance and counselling Services on Overall School Adjustment

The first objective of the study was to determine gender type and students' perceptions on the influence of guidance and counselling on school adjustment, in Keiyo North Sub-County, Kenya. To achieve this objective, the following question was asked: Are there significant statistical difference in secondary school gender type and students' perceptions on the influence of guidance and counselling on school adjustment? The null hypothesis stated; there are no significant statistical differences in secondary school gender type and students' perceptions on the influence of guidance and counselling on school adjustment. To answer the question, scores for academic, emotional and social adjustments were combined and summed up to form one variable for overall school adjustment. Thereafter, an independent t-test was computed. The descriptive results are presented in Table 2.

Table 2: Description of Gender and Influence of Services on Overall School Adjustment

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Overall school adjustment	Female	169	3.6391	.82007	.06308
	Male	160	3.4000	.90561	.07159

Results show that female participants had more positive perceptions on the influence of guidance and counselling services on their overall school adjustment ($M=3.63$ and $SD=0.82$) when compared to male participants ($M=3.4$ and $SD=0.90$). This implies that female students perceive the guidance and counselling services to be more beneficial to their school adjustments compared to male students probably because the services have been enhanced in their schools.

To test the hypothesis, an independent sample t-test was computed at 95% confidence level. The results are presented in Table 3.

Table 3: T-test for Gender and influence of Services on Overall School Adjustment

Levene's Test for Equality of Variances	t-test for Equality of Means
---	------------------------------

										95% Confidence Interval of the Difference
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Overall school adjustment	Equal variances assumed	1.428	.233	2.512	327	.012	.23905	.09516	.05185	.42626
	Equal variances not assumed			2.505	319.474	.013	.23905	.09542	.05132	.42679

The independent t-test results show that there exist significant statistical differences ($t=2.505$, $df=319.474$ and $p=0.013$) between gender and students' perceptions on the influence of guidance and counselling services on school adjustments in Keiyo North Sub-County thus leading to rejection of the null hypothesis. This implies that there exist significant statistical differences gender type and students' perceptions on the influence of guidance and counselling on school adjustment.

Class Level of the Participants

The study also sought to investigate class level and students' perceptions on the influence of guidance and counselling on school adjustment, in Keiyo North Sub-County, Kenya. Interviews and questionnaires were used to find out the class level of the participants who participated in the study. The findings were summarized and presented in Figure 2 below.

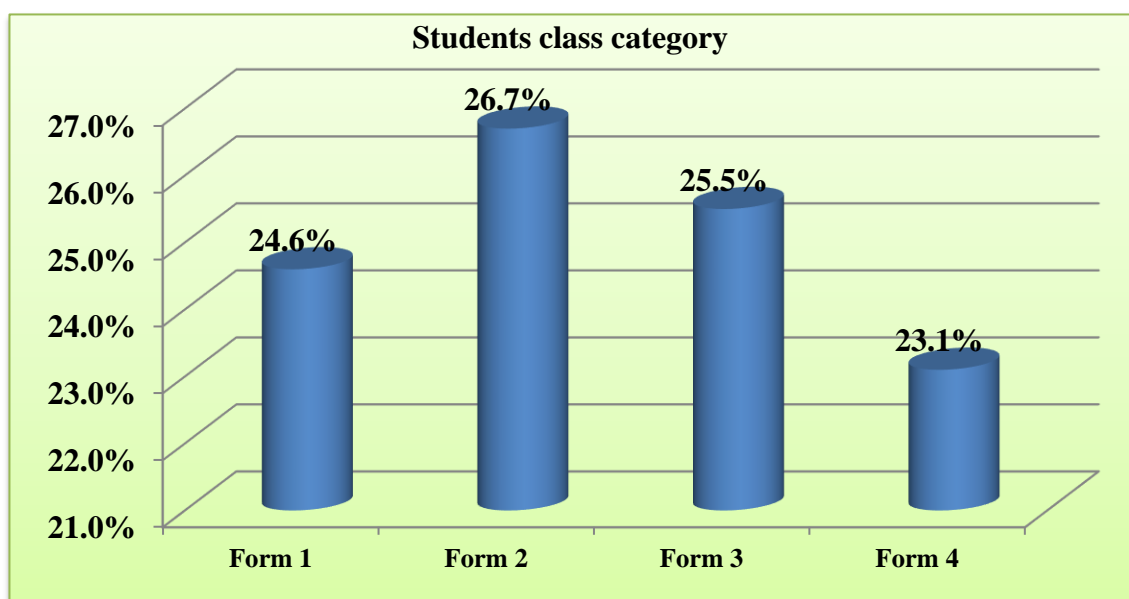


Figure 2: Class Level of Participants

Results reveal that 26.7% of the 329 participants were from Form 2, 25.5% from Form 3, 24.6% from Form 1 and 23.1% from Form 4. This ensured that all class levels were included in the research study.

Class Level Ratings of guidance and counselling Services

Table 4 below shows the class level ratings of guidance and counselling. It can be seen that the highest percentage of participants who rated guidance and counselling services as good were from Form 4 at 53.9%. This is because they have stayed in school much longer and thus benefitted more from the services. It may also be possible that a lot of guidance and counselling services are being targeted at them as they prepare for their final exams and exit from the school. They were followed closely by Form 2 class at 53.4%. The highest percentage of participants who rated the services as poor were from Form 3 classes at 45% followed by Form 1 at 32.1%. Probably Form 3 classes are neglected as they concentrate on Form 4 students. Form 1 students on the other hand may not have stayed long in school to get adequate exposure to the guidance and counselling services offered in their schools.

Table 4: Description of Class Level and Ratings of Services

Class level	Ratings			N
	Poor	Average	Good	
Form 1	26 (32.1%)	29 (35.8%)	26 (32.1%)	81
Form 2	16 (18.2%)	25 (28.4%)	47 (53.4%)	88
Form 3	38 (45.2%)	25 (29.8 %)	21 (25%)	84
Form 4	5 (6.6%)	30 (39.5%)	41 (53.9%)	76
Total	85 (25.8%)	109 (33.1%)	135 (41.0%)	329

Class Level and Influence of Services on Overall School Adjustment

The second objective of the study was to determine secondary school class level and students' perceptions on the influence of guidance and counselling on school adjustment. To achieve this objective, the following question was asked: Are there significant statistical differences in secondary school class level and students' perceptions on the influence of guidance and counselling services on their overall school adjustment? The null hypothesis stated; there are no significant statistical differences in secondary school class level and students' perceptions on the influence of guidance and counselling services on overall adjustment. The descriptive statistics results are shown in Table 5.

Table 5: Description of Class Level and Influence of guidance and counselling services on Overall School Adjustment

Overall School Adjustment

	N	Mean	Std. Deviation	Std. Error
Form 1	81	3.3457	.95080	.10564
Form 2	88	3.6705	.75386	.08036
Form 3	84	3.2857	.89942	.09813
Form 4	76	3.8026	.76629	.08790
Total	329	3.5228	.86968	.04795

The descriptive statistics results show that students in F4 were the most positive in their perceptions ($M=3.80$ and $SD=0.76$) followed by Form 2 ($M=3.67$ and $SD=0.75$), then Form 1 ($M=3.34$ and $SD=0.95$) and lastly Form3 ($M=3.28$ and $SD=0.89$). From the results Form 4 and 2 had more positive perceptions of the influence on guidance and counselling services on overall school adjustment as compared to Form 3 and Form 1 who appeared to be undecided. This may be because more guidance and counselling activities are more likely to target F 4 students as they prepare to sit their final exams and exit school. For F 2 students it is so as to counter the effects of adolescence. This is especially more so since there has always been the teachers' belief students' are at their most rebellious stage in Form 2 than in any other class. These results are graphically presented in Figure 3.

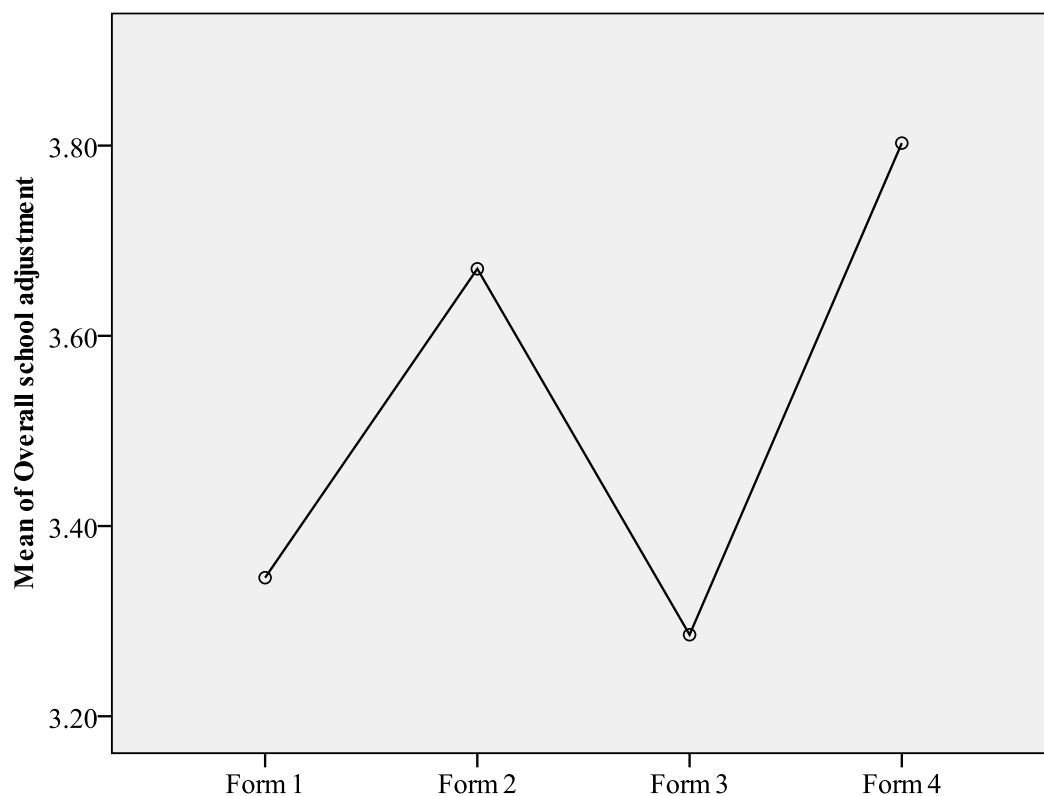


Figure 3: Class Level and Influence of Services on Overall School Adjustment.

The figure 3 illustrates that the students' perceptions on the influence of guidance and counselling services differ across the various class levels. This may suggest that the services are not provided uniformly across all the classes.

To test the hypothesis, ANOVA was computed at 95% confidence level. The results are presented in Table 6.

Table 6: ANOVA on Class Level and Influence of Services on Overall School Adjustment

Overall School Adjustment					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	15.133	3	5.044	7.037	.000
Within Groups	232.947	325	.717		
Total	248.079	328			

The ANOVA values as shown in Table 6 are $F(3, 325) = 7.037, p = 0.001$. This led to the rejection of null hypothesis and the deduction that there exist a significant statistical differences in class level and students' perceptions on the influence of guidance and counselling services on their overall school adjustment. This implies that students of Form 1, 2, 3 and 4 perceive differently on the influence of guidance and counselling on their school adjustments in secondary schools in Keiyo North Sub-County.

Type of School Attended by Participants

The study also sought to examine school type and students' perceptions on the influence of guidance and counseling services on their overall school adjustment, in Keiyo North Sub-County, Kenya. Interviews and questionnaires were used to find out the school type of the participants who participated in the study. The finding were summarized and presented in Figure 3 below.

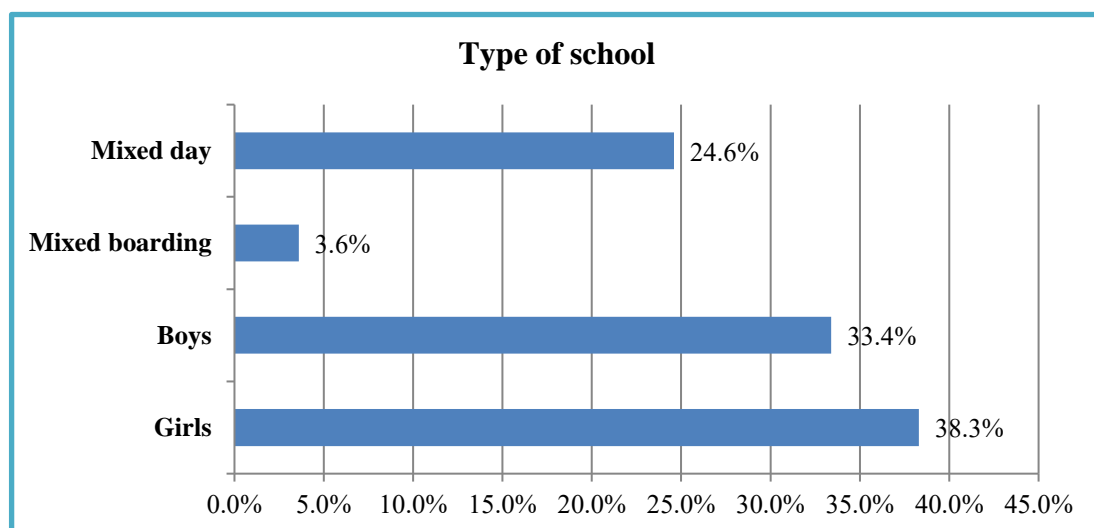


Figure 4: Type of School

Most, 126 (38.3%) of the participants were from girls boarding, 110 (33.4%) came from boys secondary schools, 81 (24.6%) were from mixed day secondary schools while 12 (3.6%) were from mixed boarding

schools. The implication is that guidance and counselling services are provided in each type of school and participants from each from each type of school were captured in their existing proportions.

School Type Ratings of guidance and counselling Services

The findings presented in Table 7 below show that only 11.9% of the participants from girls' schools rated the services as poor. They were followed by participants from mixed boarding schools whereby 16.6% of the students who participated rated the service as poor. Next was mixed day at 17.3% .The highest percentage of those who rated as poor at 49% were from boys' schools. The findings also show the highest percentage of participants who rated the services as average were from mixed boarding schools at 66.6% while the lowest percentage was from boys' boarding at 29%. On the other hand, the findings show that the highest percentage of the participants who rated guidance and counselling as good were from mixed day schools at 43.2% next was from girls' boarding schools at 22.5% followed by boys' boarding schools at 21.8% and lastly mixed boarding schools at 16.6%. The interpretation of the findings is that guidance and counselling services provision in all types of schools in Keiyo North Sub-County is wanting since less than half of the participants in each type of school rated them as good. Thus it can be concluded that service provision in all types of schools need to be improved so that a good percentage of students can rate it highly.

Table 7: Description of School Type and Ratings of Services

Type of school	Ratings			N
	Poor	Average	Good	
Girls' boarding	15 (11.9%)	37(29.3%)	74(22.5%)	126
Boys' boarding	54 (49%)	32 (29%)	24 (21.8%)	110
Mixed boarding	2 (16.6%)	8 (66.6%)	2 (16.6 %)	12
Mixed day	14 (17.3%)	32 (39.5%)	35 (43.2%)	81
Total	85 (25.8%)	109 (33.1%)	135 (41.0)	329

School Type and Influence of guidance and counselling Services on Overall School Adjustment

The third objective of the study was to determine the secondary school type and students' perceptions on the influence of guidance and counselling services on their overall school adjustment. To achieve this

objective, the following question was asked: Are there significant statistical differences in secondary school type and students' perceptions on the influence of guidance and counselling on their overall school adjustment? The null hypothesis stated; there are no significant statistical differences in secondary school type and students' perceptions on the influence of guidance and counselling services on overall school adjustment. To answer the research question, combined values for overall school adjustment were compared with scores for school type. The responses are presented in Table 8

Table 8: Description of School Type and influence of Services on Overall School Adjustment

Overall School Adjustment					
	N	Mean	Std. Deviation	Std. Error	
Girls	126	3.7302	.79411	.07074	3.5901
Boys	110	3.2545	1.03548	.09873	3.0589
Mixed boarding	12	3.1667	.38925	.11237	2.9193
Mixed day	81	3.6173	.66272	.07364	3.4707
Total	329	3.5228	.86968	.04795	3.4285

Results in Table 4.17 show that participants from girls' (M=3.73 and SD=0.79) and mixed day (M=3.61 and SD=0.66) secondary schools had more positive perceptions of the influence of guidance and counselling services on school adjustment as compared to students from boys' (M=3.25 and SD=1.03) and mixed boarding secondary schools (M=3.16 and SD=0.38) who were undecided. The results are further graphically presented Figure 4.7.

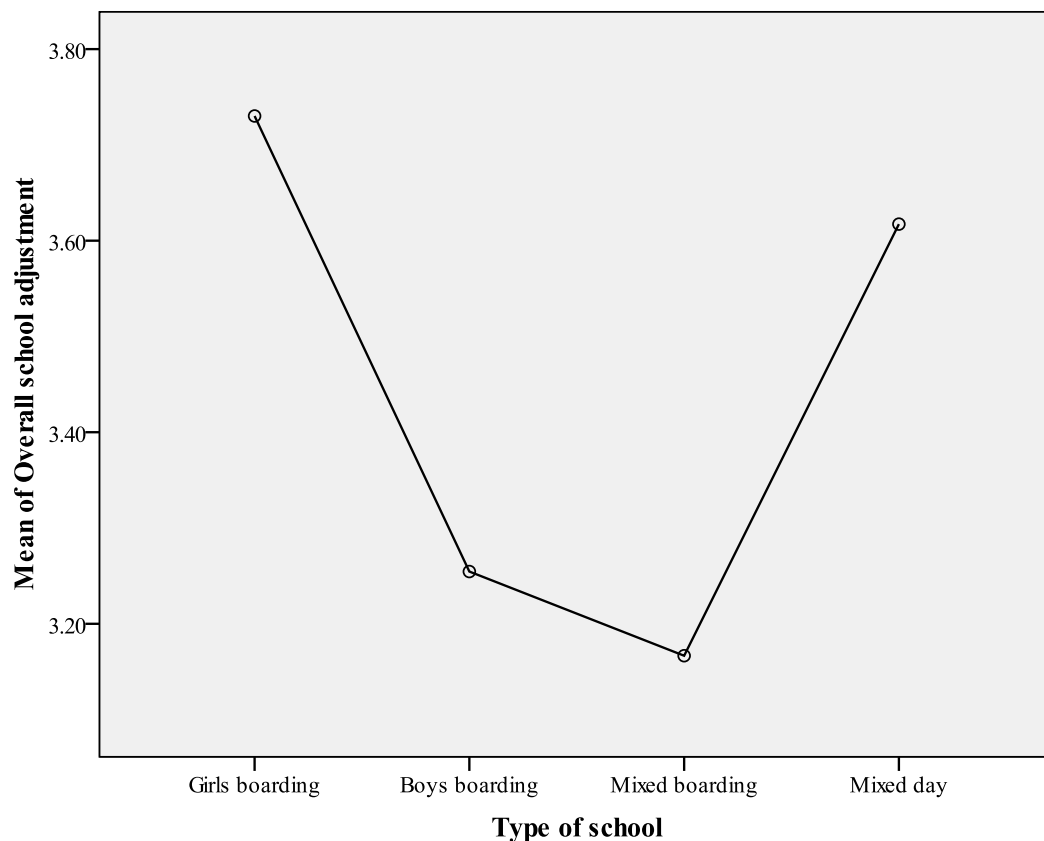


Figure 5: School Type and Influence of Services on Overall School Adjustment

Results in Figure 5 shows that participants from girls' schools and those from mixed day secondary schools have more positive perceptions on the influence of guidance and counselling services on overall school adjustment compared to participants from other types of school. Students from mixed boarding schools had the least positive perceptions. This implies that guidance and counselling services provision in secondary school may not be uniformly provided thus making students perceive the influence on overall adjustment differently.

To test the hypothesis, a One Way ANOVA was computed at 95% confidence level. The results of the analysis are given in Table 9.

Table 9: ANOVA on School Type and Influence of Services on Overall School Adjustment

Overall School Adjustment					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	15.578	3	5.193	7.259	.001
Within Groups	232.501	325	.715		
Total	248.079	328			

The ANOVA values were $F(3, 325) = 7.259$, $p = 0.001$. This led therefore, to the rejection of the null hypothesis. This implies that there exists a significant statistical differences in secondary school students' perceptions on the influence of guidance and counselling services on their overall school adjustment based on their school type. This led to the conclusion that students from girls', boys', mixed day and mixed boarding perceive differently on the influence of guidance and counselling services on their school adjustments in secondary schools in Keiyo North Sub-County.

Discussion and conclusion

The study also sought to determine secondary school students' perceptions on the influence of guidance and counselling services on their overall school adjustment in relation to gender. Descriptive statistics results revealed that gender was a factor in determining students' perceptions on the influence of guidance and counselling services on overall school adjustment. Female participants had a higher positive perceptions ($M = 3.63$) as compared to male participants ($M = 3.4$). This could be because female students view guidance and counselling services more positively than their male counterparts as noted by Chireshe (2011) and thus are likely to seek more guidance and counselling services as opposed to male students. This calls for teacher counsellors to try and bridge this imbalance as male and female students face academic, emotional and social challenges. However, these findings are contrary to Ng'eno (2012) who reported no gender differences particularly on the perception on the impact of guidance and counselling on the social needs domain of school adjustment. Additionally, the results may also imply that guidance and

counselling services in secondary schools in Keiyo Sub-County targeted more female students as opposed to male students and this could influence their perception on its effectiveness. Independent t-test computed showed that the t-values were ($t= 2.505$, $df =319$ and $p=0.013$). This led to rejection of the fourth null hypothesis and conclusion that there exist significant statistical differences in secondary school students' perceptions on the influence of guidance and counselling services on their overall school adjustment on the basis of gender.

The study also investigated secondary school students' perceptions on the influence of guidance and counselling services on their overall school adjustment in relation to school type. In this study, the type of school was based on the kind of students the schools admitted. These types of schools comprised of; girls' schools, boys' schools, mixed day schools and mixed boarding schools. Descriptive results revealed that students from girls secondary schools had the highest or the most positive perceptions ($M=3.73$) followed by those from mixed day secondary ($M=3.61$) on the influence of guidance and counselling services on overall school adjustment on the basis of school type. The other categories of schools; boys ($M=3.25$) and mixed boarding ($M=3.16$) students were undecided. This showed that students' perceptions on the influence of guidance and counselling on school adjustment varied across different types of schools. Furthermore, computed analysis of variance (ANOVA) results were $F(3,325) = 7.259$, $p = 0.001$ leading to rejection of the fifth null hypothesis. The research deducted that there existed significant statistical differences ($p<0.05$) in secondary school students' perceptions on the influence of guidance and counselling services on their overall school adjustment as far as school type was concerned. This implied that perceptions of students varied across their school categories. These findings are in line with similar studies (Chireshe, 2011, Gatua, 2012; Ng'eno, 2012; Raju et al., 2007 & Rashmikan et al., 2014) targeting different types of schools although the schools were not classified on the basis of single sex or mixed boarding and day schools. However, the results are contrary to the findings reported by Yellaiah (2012) who found no significant differences between schools classified as government and private schools and rural and urban schools in the domain of academic adjustment. These findings seem to suggest that the provision of guidance and counselling services might not be uniform in the different types of schools.

The sixth and last objective in this study was to establish secondary school students' perceptions on the influence of guidance and counselling services on their overall school adjustment in relation to class level. Descriptive statistics presented revealed that Form 4 students held more positive perceptions ($M=3.8$) as compared to Form 2 ($M=3.67$) students. However, students in Form 1 ($M=3.34$) and Form 3 ($M=3.28$) scored relatively lower means. This may mean that guidance and counselling services were not provided to the same degree in all classes in secondary schools which resulted to differences in participants' perceptions on the influence the services had. For instance, Form 4 and Form 2 students had higher perceptions when compared with those in Form 3 and Form 1 that had lower scores. In the ANOVA, results were $F(3,325) = 7.07$, $p = 0.001$. This led to rejection of null hypothesis and the conclusion that there were significant statistical differences in secondary school students' perceptions on the influence of guidance and counselling services on their overall school adjustment as far as class level was concerned.

Other researchers (Mullis et al., 2007; Ng'eno, 2012, & Watts & Thomas, 1997) also reported differences in relation to class levels.

In a nutshell, the study found a significant difference in students' demographic factors on perceptions of the influence of guidance and counselling services and school adjustment. All these differences arose due to the quality of guidance and counselling services provided in the schools as rated by the respondents. It can therefore be emphasized that guidance and counselling services provided in schools have to be of a high quality for students to have a high perceptions of its influence on their school adjustment. Indeed, the study is a call for a scaled up commitment to education stakeholders to strategize on how to provide effective guidance and counselling services in schools for enhanced school adjustment of all the students.

References

- Aduda, D. (2014, 4th March). Double Victory for Alliance as it Tops Ranking. *Daily Nation*, P.4.
- Auni, R. T., Songok, R. J., Odhiambo, O. R. & Lyanda, J. L. (2014). Determinants of Guidance and Counselling Programme in Addressing Students' Social Adjustment in Secondary Schools in Siaya District, Kenya. *International Journal of Humanities and Social Sciences*, 4 (4), 69-76.
- Baker, M. J. & Foy, A. (2008). Business and management research: how to complete your research (2nd ed.). Westburn: Scotland
- Baron, B. A., & Byrne, D. (2003). Social Psychology. New Delhi: Prentice – Hall.
- Basci, Z., & Dilekmen, M. (2009). An Analysis of Classroom Teachers Attitudes towards Corporal punishment from the Aspect of Several Variables {Electronic version}. *World Applied Science Journal* 6 {7} 933 – 938.
- Biswalo, P. M. (1996). *An Introduction to Guidance and Counselling in Diverse African Contexts*. . Dar-es Salaam: Dar -es Salaam University.
- Chireshe, R. (2011). School Counsellors' and Students' Perceptions of the Benefits of School Guidance and Counselling Services in Zimbabwean Secondary Schools. *Journal of Social Sciences*, 29 (2): 101-108.
- Cohen, L. L. Manion & K. Morrison, (2011). *Research Methods in Education (7th ed)*. London: Routledge.
- Comfort W. A. (2014). Evaluation of students' perception of school counselling and their attitudes toward its programmes, *Arabian Journal of Business and Management Review (Nigerian Chapter)*, 2(5),
- Burk, A. & Bryan, H. G. Attitudes of University students and staff to students Counselling and Research Unit Bulletin 16, 188-124.
- Comfort W. A. (2014). Evaluation of students' perception of school counselling and their attitudes toward its programmes, *Arabian Journal of Business and Management Review (Nigerian Chapter)*, 2(5), in Corney, C. G; Savitz & C. J. Weisjatt, G. N. Students Evaluation of University Counselling centre and their intention to use its programme . *Journal of Counselling Psychology*, 26, 242-249.
- Comfort W. A. (2014). Evaluation of students' perception of school counselling and their attitudes toward its programmes, *Arabian Journal of Business and Management Review (Nigerian Chapter)*, 2(5),

- in Gilazer, S. U. Counsellor Attitudes toward Counselling vocational Guidance Quarterly 8 (4) 235-238.
- Comfort W. A. (2014). Evaluation of students' perception of school counselling and their attitudes toward its programmes, *Arabian Journal of Business and Management Review (Nigerian Chapter)*, 2(5), in Mack, D. ECounselling in a Nigerian University. *Personal and Guidance Journal* 59 (9).
- Comfort W. A. (2014). Evaluation of students' perception of school counselling and their attitudes toward its programmes, *Arabian Journal of Business and Management Review (Nigerian Chapter)*, 2(5), in Mclover, M. Y. Graduates students perceptions of Guidance services in three Iowa Universities Dissertation Abstracts International 1445-A.
- Creswell J. W. & Plano Clark, V. (2007). *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA: Sage.
- Egan, E. (2002). *The Skilled Helper: A Problem- Management and Opportunity- Development Approach to Helping*. (7th ed.) Chicago: Brooke/ Cole.
- Gatua, D. M. (2012). Impact of Guidance and Counselling Services on Students' Social and Emotional Adjustment in Public and Rural Secondary Schools in Nakuru and Uasin Gishu Counties, Kenya. *International Journal of Science and Research (IJSR)*, Vol. 3 Issue 11, 1-8.
- Gitonga, M (2007b). How to read silent messages by pupils, *Teachers' image*, Vol. 13, 43 – 44, Nairobi.
- Gitonga, M. (2007a).How to deal with student indiscipline, *Teachers' Image*, Vol. 13, 45 – 46, Nairobi.
- GoK (2001). The children's act, 2001. Kenya Gazette Supplement No.95, Acts No.8 Nairobi Kenya: The Government printer.
- KIE & LISP (2003).Guidance and Counseling, Teacher's Handbook, Nairobi: KIE
- Kibet, L. (2014, October). Students Admit to Smoking Bhang, Cigarettes. *The Standard*. P.18, col.1-4.Nairobi: The Standard Goup Ltd.
- Lutomia, G.A., &Sikolia, L. W.(2008).Guidance and Counseling for Schools& Colleges,Nairobi: Uzima Publishing.
- McGuiness, J. (1998). *Counselling in Schools. New Perspective*. London: Cassell.
- Mullis, F. & Otwell, P. (2007). Counsellor Accountability: A study of Counsellor Effects on Academic Achievement and Student Behaviour. *Georgia School Counsellors Association Journal*, 1: 4, 4-12.
- Mutie , E. K. & Ndambuki, P. N. (2004). *Guidance and Counselling for Schools and Colleges* (6th ed.). Nairobi: Oxford University Press.
- Mullis, F. & Otwell, P. (2007). Counsellor Accountability: A study of Counsellor Effects on Academic Achievement and Student Behaviour. *Georgia School Counsellors Association Journal*, 1: 4, 4-12.
- NACADA (2011). *Role of School Environment in Alcohol and Drug Abuse Among Students of Public Secondary Schools in Nairobi*. Policy Brief. No. 2/2011. www. nacada. Go. Ke.
- Nasilumbi, W. J., Jenniffer, M. K., & Prisca, T. (2016). Teachers' Demographic Factors on Attitude Towards Guidance and Counselling Services in Public Primary Schools of Kimilili Subcounty, Kenya. *Journal of Education and Practice*, 7(31)
- Ndondo, O. (2004). *Guidance and Counselling for Schools and Colleges*. Nairobi: Oxford University Press.

- Ndirangu, P. N. (2007). *The Influence of Guidance and Counselling Programme on Academic Performance of Selected Public Secondary School Students: A Case of Bahati Division, Nakuru District*. Unpublished Master's Thesis. Egerton University.
- Ng'eno, G. K. (2012). *Teachers' and Students' Perception of the Impact of Guidance and Counselling Programme on the Satisfaction of Selected Needs of Kenyan Secondary School Students*. Unpublished D. Phil. Thesis. Moi University, Eldoret.
- Ngesu, L. Ndiku, J. & Maseke, A. (2008). Drug Dependence and Abuse in Kenya Secondary Schools: Strategies for Intervention. *Educational Research and Review*, Vol. 3 (10) pp 300-308.
- Nweze, T. & Ugochukwu, O. (2014). Counselling Needs Assessment Survey of Technical College Students: An Ebonyi State study. *International Journal of Education and Research*, Vol. 2 No. 10 371-383.
- Ocharo, J.B.O., and Oduol, T. (2009 January – April). School Strikes: Beneath the surface. *Elimu News*, 4, 7 – 9.
- O'Donoghue, T & Punch, K. (2003). *Qualitative Educational Research in Action: Doing and Reflecting*. Routledge.
- Raju, M. V. R. & Rahamtulla, T. K. (2007). Adjustment Problems Among Students. *Journal of the Indian Academy of Applied Psychology*. Vol. 33, No. 1, 73-79.
- Rashmikant, N. P & Shree, P. G. (2014). A study of Certain Areas of Adjustment of Higher Secondary Schools, Students in Relation to Habitat. *International Journal for Technical Research in Engineering*. Vol. 1 Issue 6, 402-406.
- Republic of Kenya. (2010). *Education for Sustainable Development: Information Strategy*. Nairobi: Senabara Design House.
- Seyoum, Y. (2011). Revitalizing Quality Using Guidance and Counselling in Ethiopian Higher Institutions: Exploring Students' Views and Attitudes at Haramaya University. *International Journal of Instruction*. Vol. 4, No. 2 161-192.
- UNESCO (2000). *New Roles and Challenges for Guidance and Counselling*. Paris: iac.
- Watts, V. & Thomas, B. (1997). Proving that Counselling Programs Do Count: The Counselling Accountability. *Georgia School Counsellors Association Journal*, 1: 4-13.
- Wentzel, K. R. (2003). School Adjustment. In Weiner, I.B. (Editor-in-chief), *Handbook of Psychology (vol. 7), Educational Psychology*. pp.235-258). New Jersey: John Wiley and Sons Inc
- Yellaiah, N. S. (2012). A Study of Adjustment on Academic Achievement of High School Students. *Journal of Social Science and Interdisciplinary Research*. Vol. 1. No. ISSN 2277 3630.

The reasons for and consequences of the combined use of crack cocaine and alcohol in Brazil: a qualitative study

Janaína Rubio Gonçalves (1st author)

Dept. of Preventive Medicine, Universidade Federal de São Paulo
São Paulo, Brazil

Solange Aparecida Nappo (Corresponding author)

Brazilian Center of Information on Psychotropic Drugs, Dept. of Pharmaceutical Sciences,
Universidade Federal de São Paulo
São Paulo, Brazil

Abstract

The objective of this study was to investigate, through the speeches of crack cocaine users, the reasons that lead them to combine crack cocaine with alcohol and the consequences of this combination, in Brazil. The lack of public policies and effective treatments has led crack cocaine users in Brazil to seek alternatives to cope with problems related to drug addiction. One adopted alternative is the consumption of crack cocaine together with other psychotropic drug. This study used the principles and instruments of qualitative research. A purposeful sample was constructed using key informants and gatekeepers whose sample size (N = 30) was defined by the theoretical saturation point. The study participants were subjected to in-depth interviews, and the responses were subjected to content analysis for the identification of thematic units. Alcohol use played many roles, including increasing the courage of drug users to go to the point of sale for psychotropic drugs, reducing thirst, and prolonging the positive effects of crack cocaine. The combination of alcohol and crack cocaine is commonly used to modulate the effects of the latter. A vicious cycle is established in which the consumption of alcohol stimulates the consumption of cocaine and vice versa. The participants also reported cost savings but admitted an increase in aggressiveness. The combined use of crack cocaine and alcohol can become a strong conditioned stimulus for the consumption of the former. The formation of the active metabolite cocaethylene in this drug combination may explain the prolongation of the effects of crack cocaine. Moreover, both drugs act in the mesolimbic dopaminergic system and consequently produce a synergistic effect. Severe outcomes such as cardiotoxicity, which can lead to death, in addition to aggression and the possibility of relapse to crack cocaine use, make this drug combination a public health problem that is greater than the individual consumption of these psychotropic drugs.

Keywords: crack cocaine, alcohol, crack cocaine and alcohol association, Brazil

1. Introduction

The first crack cocaine seizure made by the Civil Police of São Paulo occurred in 1991 [1]. The

characteristics of the drug, including ease of use, low price, rapid and intense effect, and lower probability of HIV infection, led to the rapid acceptance of crack cocaine by drug users [2, 3].

In this period, Brazil was experiencing an HIV/AIDS epidemic, in which intravenous cocaine users were a risk group [4]. In this context, crack cocaine has become an alternative for these users who first began using crack cocaine to avoid HIV infection [5].

Health professionals were focused on this scenario and considered [5, 6] that the change in the route of cocaine consumption was a harm-reduction strategy because HIV infection was decreased in places where the intravenous route was replaced by the pulmonary route [7].

This situation may have contributed to the fact that health professionals who were involved in addiction care underestimated the severity of the crack cocaine epidemic at that time, although drug problems had already started to emerge [8]. Moreover, this situation was likely responsible for the state's late response to drug problems, with the first crack cocaine program of the Brazilian government being launched in 2011, twenty years after this psychotropic drug became available [9].

The lack of public policies and the lack of effective treatments for crack cocaine addiction [10] may have led crack users to seek their own strategies to cope with the problems related to drug addiction. Some researchers investigated these strategies and highlighted that the combination of crack cocaine and other psychotropic drugs modulates the effects of the former [11-13]. Oliveira and Nappo [3] evaluated crack cocaine users and reported that the use of drug combinations could modulate the intensity or duration of the effects of this drug either by decreasing the adverse consequences or intensifying and prolonging the favorable effects.

Gonçalves and Nappo [12] analyzed the association of marijuana with crack cocaine and observed that the craving for the latter was decreased with the use of the former.

However, in addition to marijuana, alcohol has been used in combination with crack cocaine in Brazil. The most recent national survey on crack cocaine use in Brazil conducted by the Oswaldo Cruz Foundation (FIOCRUZ) [14] revealed that among the drug users interviewed, 64% of women and 73% of men reported using the crack cocaine-alcohol combination, demonstrating that this drug combination is common. International studies also reported the use of this combination, and 50% to 90% of cocaine users reported using alcohol [15, 16].

The literature indicates that the main reason for this drug association is the ability of alcohol to modulate the effects of crack cocaine [17]. However, considering the physical, psychological, and social problems caused by alcohol, this association is a cause for concern. This concern is further supported by data from the 2014 Global Status Report on Alcohol and Health of the World Health Organization [18], which reported that alcohol consumption causes 3.3 million deaths per year and accounts for 5.9% of all deaths worldwide. This percentage is higher than that attributed to HIV/AIDS (2.8%) or violence (0.9%). In Brazil, the situation is worrying, and data from the II National Survey of Alcohol and Drugs (Levantamento Nacional de Álcool e Drogas–LENAD) [19] indicate that the prevalence of alcohol addiction in 2012 was 10.48% among men and 3.63% among women.

Considering the limited number of studies that have explored the consequences of the combined use of crack cocaine and alcohol from the perspective of the user, the objective of this study was to identify the reasons for and consequences of the combined use of these two psychotropic drugs in Brazil.

2. Materials and Methods

A qualitative methodology was used because it allowed us to analyze study participants' beliefs about the combination of alcohol and crack cocaine based on their own views and concepts [20-22].

2.1 Sample recruitment

Eight key informants (KIs) were selected during the first phase of the study - two psychiatrists, four ex-crack cocaine users and two psychologists – who had varied knowledge about the study topic and the study population [22]. These KIs were invited for an informal conversational interview without a previously prepared script. Relevant questions regarding the topic arose in the context of these conversations [23, 24]. The interviews were recorded, transcribed, and analyzed, and the data generated was then used by the researchers to prepare an interview script that was used with the study participants (crack cocaine users who associated alcohol) [22]. Due to difficulties in accessing the study population due to the illegality of crack cocaine use, some of the KIs also played a gatekeeper role (i.e., they provided access to the study participants) [20]. Because the gatekeepers were known by the study population, they inspired the trust of the drug users, facilitated the participation of that population in the study, and were the first point of contact between the study population and the researchers. Each gatekeeper identified potential participants and discussed the study with them prior to introducing the researchers. Those who agreed to participate were instructed to contact the researchers. In-depth interviews were conducted using purposeful sampling, the components of which followed particular criteria (criterion sampling) [22]: crack cocaine users who were older than 18 years of age and who had combined crack cocaine with alcohol use a minimum of 25 times, thereby ensuring that experimental users were not included in the sample [25]. These criteria led to a sample size of 30 participants, all of whom were selected in the city of São Paulo during the years 2012–2013. The first interviewees who were contacted by the KIs identified other possible participants, thereby using the snowball technique to compose the sample. Sampling using the snowball technique starting with the first interviewee created a chain of interviewees [24, 26]. To include the largest possible number of user profiles in the sample who met the inclusion criteria proposed, various chains of interviewees were sought, and seven chains were identified, which ranged from 3 to 5 individuals each. The sample size was adequate to cover all of the topics of interest and various user profiles. This assumption was met when the interviewees' responses became redundant. At this point, termed the theoretical saturation point, the lack of new information and the repetition of responses were identified [20, 22, 24].

2.2 Instruments used

Semi-structured interviews were conducted using a script of topics that were selected based on the information provided by the KIs [22, 23]. The script was composed of previously standardized questions to facilitate comparisons among responses and reduce interviewer interference. Additional questions emerged to clarify specific topics during each interview, allowing for improvement of subsequent understanding [23, 24]. The script consisted of socio-demographic data, history of drug use, history of crack cocaine use, associated alcohol use, and damages/"advantages" of the combination. The questions relating to the socioeconomic data were evaluated using the *Brazilian Economic Classification Criteria*

2008 scale, published by the ABEP (Brazilian Association of Research Companies-*Associação Brasileira de Empresas de Pesquisa*) [27]. This scale mainly considers the consumer goods possessed by the family and classifies respondents into classes A1, A2, B1, B2, C, D and E (A1 is the category with the greatest ownership, whereas E delineates a lack of ownership and includes the homeless). The criteria for dependency, as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) [28], were also incorporated into the script. After obtaining the consent of the interviewees, the interviews were recorded, each of which lasted approximately 70 min.

2.3 Qualitative analysis of the content

Each interview was identified by an alphanumeric code in which the first letter was the first initial of the interviewee's name, followed by his or her age and gender. The interviews were transcribed and reviewed by the researchers. They were then analyzed using the content analysis technique based on Bardin's theoretical framework [29]. The various parts of the interviews were split and then grouped according to each research theme. For the analysis, NVivo Software Version 10 [30] was used, which allowed for greater data analysis consistency and facilitated organization. The importance of the themes identified was analyzed by considering the emic approach. This step, defined as categorization, was developed by the two researchers who independently and simultaneously analyzed the data. Then, these two analyses were compared to obtain consistency and coherence in the results. Finally, inferences supporting the explanations were initiated and conclusions were generated. *Quotes* from the interviewees' statements are presented in the results section; they are identified by their code and shown in italics.

3.Results

3.1 Sample characteristics

Most of the study population were young men (18 to 30 years old), with low socioeconomic status (classes E and D according to ABEP classification) [27] and little schooling (incomplete elementary education). Only eight respondents reported living with their families, and the remaining lived on the streets or in shelters. Approximately 90% of the participants were unmarried and unemployed at the time of the interview. All participants were considered dependent on crack cocaine and alcohol according to DSM IV criteria [28].

3.2 History of drug use

None of the interviewees reported using crack cocaine as the first drug of choice. Licit drugs such as alcohol and solvents were the most common as starting drugs. Moreover, almost all participants reported having used cocaine in the form of aspirates and/or injectable and marijuana. A small percentage of the sample also reported having used LSD, psychotropic drugs, and ecstasy. Crack cocaine began being used by this population after this sequence of drugs.

3.3 Problems related to drug abuse

Drug use was not always recreational, and all study participants reported having problems related to the

abuse of psychotropic drugs. However, all respondents indicated that crack cocaine was the drug that most affected them psychically, physically, and particularly socially, leading to marginalization, theft, and loss of social status, financial status, employment, and family.

3.4 Strategies used to address drug abuse

The study sample reported having adopted some strategies to cope with the problems related to crack cocaine use, including the search for medical treatment, attachment to religion/spirituality, use of other psychotropic drugs to replace crack cocaine, avoiding carrying cash, and the combination of crack cocaine with other drugs. This last factor was explored in this study but was limited to the association of crack cocaine and alcohol.

3.5 Choice of drug combination

The analysis of the criteria used by the participants for choosing the drug combination indicated that this decision was simple. The choice was based on information from friends and/or experimentation and the consequent evaluation of the effects of the tested association. Crack cocaine was most commonly combined with alcohol and/or marijuana.

I did not like marijuana, so I traded for beer, then for cachaça and gin. (S33M)

Alcohol makes me want to use crack. Marijuana relaxes me. I become sleepy. (C29M)

The respondents were asked whether the drug dealer at the time of the purchase of crack cocaine advised them to associate crack with other psychotropic drugs. All respondents replied that there was no dialogue with the drug dealer because the dealer did not allow this type of approach. The contact with the drug dealer was fast enough for the consumer to buy the drug and leave the point of sale.

There was no dialogue. The drug dealer does not want to talk to us because he is in the condition of a seller, a condition higher than mine is, and I am in the condition of an addict and buyer (C21M).

In addition, the drug dealer did not allow the consumption of crack cocaine in the vicinity of the point of sale because this situation could jeopardize the security of the place, which could be identified by the police, reinforcing the sparse dialogue between dealers and users.

There is no conversation. You buy what you want and cannot smoke there. You have to smoke somewhere else. Smoking there could put my life at risk (F30M)

3.6 Combination of crack cocaine and alcohol

3.6.1 Type of alcoholic beverage used in association with crack cocaine

Cachaça (Brazilian alcoholic beverage extracted from sugarcane with an alcohol content of 38–48%) was mentioned by most of the interviewees as the beverage of choice for combination with crack cocaine because the beverage is inexpensive and easily accessible.

The drug users could not dispense with alcohol after they started using the crack cocaine-alcohol combination. Moreover, in the absence of an alcoholic beverage, the participants used other alcohol-containing products, some of which were not indicated for human consumption, including fuel ethanol, deodorant and substance that removes nail polish (acetone).

I have already drunk acetone with water to lower the effect of smoking crack. I need to drink something, even acetone or fuel alcohol. (C33M)

I drank deodorant. I had nothing to drink, I arrived at a friend's house, I needed alcohol, he offered me deodorant. I drank the whole bottle. (A19M)

Fuel ethanol was also consumed in the absence of cachaça.

I would not smoke without alcohol. I needed to have at least R\$ 1 (USD 0.25) in my pocket. With this money, I would buy alcohol from the gas station, mix it with water, add sugar, and drink it (24M).

3.6.2 Reasons for using the cocaine-alcohol combination

3.6.2.1 Facilitates the daily routine of the drug user

- *Increases courage*

The participants reported that going to the point of sale was dangerous. The lack of intimacy with the drug dealer and the rules imposed by traffic worsened the situation. Some interviewees witnessed the death of friends at the point of sale and therefore were afraid to go to these places. However, the consumption of alcohol gave them courage to buy cocaine. The disinhibition caused by alcohol and the desire to consume cocaine made them audacious.

Alcohol disinhibited and gave me the courage to go to the point of sale and buy crack. I drank three doses of cachaça and afterwards was not aware of anything. I was going to the point of sale and did not care who was on my way. Nothing stopped me, not the police, my mother, or my family. I completely lost my fear (G24M).

- *Use of alcohol to replace crack*

It is important to highlight that, in these cases, alcohol was not used to replace the effects of crack but had an auxiliary role, i.e., it was consumed because the user was forced into abstinence by not having the means to buy crack cocaine.

Crack was finished and what now? ... I have no money to buy ... I have nothing else to sell, what am I going to do? Drink alcohol. (A19M)

3.6.3.2 Modulates the physical and psychological effects of crack cocaine

- *Reduces thirst*

The respondents reported that the consumption of crack cocaine made them thirsty. The mouth became dry during crack consumption, and the most pleasant beverage at that time was an alcoholic beverage. Water could not fulfill the role of relieving thirst, and some participants even attributed negative consequences to water consumption.

When I smoke crack, the mouth starts to dry, so I need to drink some liquid, but never water. Water will diminish the effect of the drug, and the stomach does not accept water in this condition. It can be beer, cachaça, or other alcoholic beverages. (P34M)

- *Reduces the negative effects of crack cocaine and relaxes the user*

The interviewees reported using alcohol to reduce the harmful consequences of crack cocaine. After crack cocaine consumption, the users wanted to relax and only achieved this state with alcohol. The participants reported that alcohol limited the adverse effects of crack cocaine and promoted a state closer to normal.

I smoked crack and drank alcohol. Alcohol eliminates some of the effects of crack. It prevents me from getting too crazy. I was more in control and did not have paranoia (T24M).

Some participants reported that crack cocaine hampered sleep whereas alcohol contributed to sleep.

Crack with alcohol helps me to sleep. To sleep, I would drink half a liter of alcohol and I would be relaxed. Whenever I went to bed, I carried a bottle of alcohol and drank in big sips (P23M).

- Prolongs the positive effects of crack cocaine

Most respondents reported that the pleasurable effects of crack cocaine were prolonged in the presence of alcohol. With the extended use of crack cocaine, the favorable effects are significantly reduced and are replaced by transient paranoid symptoms. Therefore, alcohol is consumed to prevent or decrease these symptoms and prolong the positive effects of crack cocaine.

After using only crack for some time, the positive effect of the drug disappears. In this instance, I am smoking only because of the paranoia. With alcohol, I feel the effects of crack a lot longer, and the paranoia almost disappears (S24M).

Alcohol was also used to decrease the craving for cocaine, and this goal was achieved with the use of this drug combination.

Alcohol cuts off the craving, the desire to use crack again. So, I drank alcohol to get drunk, and this state diverted my focus from craving and I forgot about it. (F30M)

3.6.3 Consequences of the use of the cocaine-alcohol combination

3.6.3.1 Aggressiveness

The respondents reported that this drug combination triggered aggressiveness. Some individuals reported that this feeling led them to violent and risky behavior and the loss of control of drug consumption.

I was not the same person. I was strange. I was aggressive. Anything would spark my desire to fight. One of those times I hit a guy so hard I almost killed him. I thought he stole my drug. (R32M)

3.6.3.2 Alcohol increases the desire to use crack cocaine and vice versa

Not all participants could control the unpleasant effects of crack cocaine with alcohol consumption. Over time, alcohol use triggered the craving for crack cocaine and vice versa, with the aggravating outcome that the craving for crack cocaine was added to the craving provoked by the alcohol.

I drank alcohol after smoking ... the more I drank, the more I wanted to use crack. Even if I did not use crack cocaine for 3 days, if I drank alcohol immediately the urge to use crack cocaine happened. I drank and smoked and vice versa until I ended up in the hospital. (F34M)

A vicious cycle of drinking and smoking seems to occur, and drug users cannot end or limit this cycle. In fact, users can only interrupt this cycle after the occurrence of a severe outcome due to alcohol or crack cocaine poisoning or both, which can lead to hospitalization.

When I drink alcohol, the urge to smoke crack comes. When I smoke crack, the urge to drink alcohol comes. Each time I want more and more. I am gradually killing myself. I have been on this cycle of drinking alcohol and smoking crack for a long time. I will eventually have an overdose and die. (D35M)

3.6.3.3 Investment savings

The respondents reported spending less money on this drug combination. Reducing crack cocaine consumption by reducing the craving for crack cocaine with alcohol resulted in cost savings. Nonetheless, despite the cost savings with crack cocaine, there was a considerable expenditure on the purchase of alcohol.

If I usually spend R\$ 200 (approximately USD 57 dollars) a night with crack and alcohol, only R\$ 20 (USD 5) is used for the purchase of crack and the rest is spent on alcohol. (H42M)

However, cost savings cease to exist after the installation of the vicious cycle of crack cocaine-alcohol consumption.

As soon as I finished smoking crack, the first thing that came to my mind was alcohol. It was instant and endless. I spent all my money buying crack and alcohol. (R27M)

3.6.4 Situations that favor the use of the cocaine-alcohol combination

The optimal time for alcohol intake was an individual decision that was directly correlated with the effect sought with the use of this drug combination.

The analysis of the reports suggested a rational choice about the optimal time to use this drug combination. Drug addicts usually drink alcohol before using crack cocaine to further stimulate crack cocaine consumption. In this context, alcohol facilitated crack cocaine consumption.

Sometimes I used alcohol first and then I wanted to use crack. (C33M)

By contrast, those who ingested alcohol after using crack cocaine intended to modulate the effects of the latter.

I actually use crack before drinking alcohol. Alcohol comes later and helps me have a pleasant effect. (P34M)

However, this rationale was not maintained over time for many respondents, who indifferently used these two psychotropic drugs concomitantly.

4. Discussion

The interviewees reported that alcohol had many functions during crack cocaine addiction, including: increasing their courage to go to the point of sale to buy the drug, reducing the harmful effects of crack, and prolonging the favorable effects. However, the unpleasant effects of this combination are severe enough to discard the use of alcohol as a strategy to mitigate the damage caused by crack cocaine.

The study sample consisted primarily of young men, with little schooling and low socioeconomic status, who were single, unemployed, and living on the streets or in shelters. These characteristics agree with the official profile of crack consumers defined by Fiocruz [14].

The study participants revealed that before starting this drug combination, alcohol consumption was beneficial to them by giving them the courage to go to the point of sale to buy crack cocaine. In Brazil, violence at the point of sale is one of the greatest risks for crack users [11]. Haasen and Krausz [31] claimed that crack-related homicides were directly related to the risks posed by the illicit drug market. According to the Ribeiro et al. [11], drug dealers impose rules in these places, and noncompliance with these rules puts users at risk, including the risk of death. The prohibitions include failing to honor debt

with the dealers, stealing, or using psychotropic drugs in the vicinity of the point of sale; these rules are not easily met by crack cocaine user. The high demand for the drug and the developed craving cause these users to remain too long at the point of sale and suffer the consequences of disrespecting the rules in these areas. Therefore, the fear of going to the point of sale is well founded. The interviewees consumed alcohol to reduce their apprehension and give them the courage to confront unsafe conditions at the point of sale. However, alcohol impairs judgment on the dangers of risk behaviors, and thus, the consumption of alcohol to confront the dangers at the point of sale can be detrimental to these users, whose ability to acknowledge the associated risks is jeopardized [32, 33].

Another important finding is that many alcoholic beverages are consumed in combination with crack cocaine, including those not intended for human consumption, such as fuel alcohol. In some cases, the respondents used acetone in the absence of alcohol. Alcohol appears to be essential for crack cocaine use, and there is cross-sensitivity between these two drugs [31]. Lau-Barraco e Schmitz [34] reported that crack users were asked to choose between crack cocaine and/or alcohol use and preferred the drug combination rather than each drug individually. The authors consider that because alcohol and crack cocaine are consumed together and repeatedly, from a behavioral point of view, one drug may become a strong conditioned stimulus for the consumption of the other, and abstaining from one drug when the other is being consumed is difficult Lau-Barraco e Schmitz [34]. Fox et al. [35] found that access to one of these drugs during abstinence in users who used the cocaine-alcohol combination increased the self-reported craving for both drugs, reinforcing the hypothesis of a conditioned stimulus. This mechanism would explain, at least in part, how alcohol consumption increases cocaine consumption and vice versa [36, 37]. Thirst seems to be an unpleasant symptom caused by the reduction of salivary flow due to cocaine consumption, accompanied by xerostomia [38]. The authors claim that hyposalivation may lead to oral burning, soreness, or altered taste sensations [39], which increases the need for water intake by cocaine users. However, the respondents argued that despite the thirst, they preferred alcohol to water. In this respect, Knackstedt et al. [40] evaluated rats pretreated with cocaine and observed that the animals preferred ethanol to sweet water. The authors attributed this preference primarily to the anxiolytic effect of alcohol, which would motivate the alcohol intake of cocaine users.

The respondents indicated that the crack cocaine-alcohol combination prolonged and enhanced the euphoric effects of crack cocaine. This assertion is supported by the fact that this drug combination leads to the formation of cocaethylene (CE), an active metabolite homologous to cocaine [41]. CE causes euphoric effects similar to those produced by cocaine [42] but has a longer action and is less anxiogenic than cocaine [37, 43], and these factors may explain the improvement of the pleasurable effects of crack cocaine and the decreased craving for cocaine. Knackstedt et al. [40] observed that the longer duration of CE action might mask the onset of the anxiogenic effects of crack cocaine and thus produce a more desirable effect for the drug user. Bunney et al. [44] reported that the improvement of the effects of crack cocaine might occur because the mesolimbic dopaminergic pathway mediates the reinforcing effects of alcohol and cocaine, and therefore, the two substances act synergistically to increase dopaminergic activity. This characteristic might contribute to the co-abuse of these psychotropic drugs [31].

Gossop et al. [37] found differences in the pattern of combination of alcohol with cocaine powder or crack cocaine, demonstrating that the route of administration of the drug interferes with this pattern. Crack

cocaine users tend to use alcohol at the end of the crack use session and consume smaller amounts of alcohol. The authors observed that in contrast to cocaine powder users, crack cocaine users consume smaller amounts of this psychotropic drug when combined with alcohol. These findings are in line with the responses of the interviewees, indicating that smaller amounts of crack cocaine are consumed in the presence of alcohol. However, it is unclear whether the consumption of alcohol was lower. In addition, the finding by Gossop et al. [37] that alcohol was consumed only after crack cocaine consumption was not observed in our study. In our sample, the timing of the drug combination depended on the purpose of the user, i.e., the consumption of alcohol before crack cocaine use was intended to stimulate the consumption of the latter, whereas the intake of alcohol after crack cocaine use was intended to decrease the craving for cocaine and prolong its positive effects.

Brache et al. [17] analyzed the reasons and consequences of using the cocaine-alcohol combination and observed that there was a significant financial cost in the consumption of the two psychotropic drugs. By contrast, the study participants stated that they saved money when using the drug combination. This statement seems plausible because the respondents stated that alcohol use decreased the consumption of crack. This difference in discourse reinforces the findings of Gossop et al. [37] about the existence of different patterns of alcohol and cocaine association depending on the route of administration of cocaine. However, cachaça, a Brazilian alcoholic drink that was cited by the interviewees as the drink of choice in the drug association, is inexpensive (one liter of cachaça costs approximately USD 1), which may contribute to the lower costs of the drug combination. However, this does not indicate a low consumption of alcohol. Another factor to be considered is that the cost savings cease to exist when the consumption of one drug leads to the consumption of the other and vice versa.

One of the adverse consequences of the use of the drug combination cited by the respondents was aggressiveness. Several studies reported an increase in the number of injuries and violence caused by alcohol consumption [45, 46]. However, the association of cocaine and alcohol is related to more severe psychological problems [36] and in particular with an increment of suicidal and homicidal behavior [47] with respect to the use of cocaine or alcohol alone. Considering the synergistic effect of crack cocaine and alcohol, the authors claim that this drug combination may lead to violent thoughts and an increase in aggressive behaviors [48]. Other studies also identified this problem, and users of this drug combination presented adverse outcomes, including non-consensual sexual intercourse and criminal activities [36, 37]. In this respect, the authors claim that alcohol consumption produces a conditioned motivational state for cocaine use by increasing the craving for cocaine. This phenomenon may lead to relapse to crack cocaine use [49]. This result reinforces the findings of McKay et al. [50], who found that 62% of those who experienced relapse to cocaine use within 6 months of treatment consumed alcohol on the same day of relapse.

The concomitant addiction to these two drugs is another cause for concern [51]. The use of alcohol seems to be a unique feature of crack cocaine users considering that all study participants were dependent on both drugs. Previous studies found similar results, including the Epidemiological Catchment Area study developed in the United States, which reported that 85% of cocaine addicts were also alcohol abusers [52]. Other studies indicated a high prevalence of alcohol addiction ($\geq 60\%$) among cocaine addicts [53, 54]. This group of users, simultaneously addicted to these two drugs, presents much more difficulties to be

treated [55] and some authors believe that this population does not respond to the available treatments [53, 56].

Cardiovascular complications are the most significant problems caused by the cocaine-alcohol combination [57]. This drug combination is arrhythmogenic, and the resulting cardiotoxicity is greater and more prolonged than that caused by crack cocaine alone [41, 42]. These symptoms occur because of the formation of CE, which is more toxic than cocaine [58, 59]. In addition, CE potentiates adverse events such as ischemia, infarction, and arrhythmia associated with cocaine [60]. These events lead to high mortality among users of this drug combination, as reported by Lucena et al [61], who found that alcohol was involved in approximately 76% of cocaine-related sudden deaths.

5. Conclusion

Although the intention of crack cocaine users to combine cocaine with alcohol is to modulate the unpleasant effects of crack cocaine, practice has shown that the consequences of this combination are severe. The cross-sensitivity between these two drugs leads to the consumption of crack in the presence of alcohol and vice versa and may lead to relapse to crack cocaine use during the abstinence period. Furthermore, aggressiveness, which is a risk behavior in this group, and severe cardiotoxicity, which may cause death, make this drug combination a public health problem greater than the individual consumption of these drugs.

6. Acknowledgments

This study was part of the first author's master dissertation and was supported by Brazilian Information Center on Psychotropic Drugs (CEBRID- Centro Brasileiro de Informações sobre Drogas Psicotrópicas). The authors thank CAPES for the master fellowship to the first author.

Ethics approval and consent to participate

The study protocol was approved by the Research Ethical Committee of the Federal University of São Paulo (CEP 1602/11). In the study, oral informed consent was obtained from each participant at the beginning of the initial interview after they were given information about the study and informed that they could withdraw at any time. With permission, interviews were recorded using a digital recorder and later transcribed in full. Anonymity of participants was maintained.

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/>).

7. References

1. Dunn J, Laranjeira RR, Da Silveira DX, Formigoni ML, Ferri CP. Crack cocaine: an increase in use among patients attending clinics in São Paulo: 1990–1993. *Substance Use & Misuse*. 1996;31(4):519–27.
2. Nappo SA, Galduróz JCF, Noto AR. Crack use in São Paulo. *Substance Use & Misuse*. 1996;31(5):565–79.
3. Oliveira LG, Nappo SA. Characterization of the crack cocaine culture in the city of São Paulo: a controlled patterned of use. *Rev Saude Publica*. 2008;42(4):664 –71.
4. Grangeiro A, Silva LL, Teixeira PR. Resposta à aids no Brasil: contribuições dos movimentos sociais e da reforma sanitaria. *Pan Am J Public Health*. 2009;26(1):87–94.
5. Bastos FI, Szwarcwald CL. AIDS and pauperization: principal concepts and empirical evidence. *Cad Saúde Pública*. 2000;16(1):65–76.
6. Fonseca EM, Nunn A, Souza-Junior PB, Bastos FI, Ribeiro JM. Decentralization, AIDS, and harm reduction: the implementation of public policies in Rio de Janeiro Brazil. *Cad Saúde Pública*. 2007;23(9):2134–44.
7. Mesquita F, Kral A, Reingold A, Bueno R, Trigueiros D, Araujo PJ, et al. Trends of HIV infection among injection drug users in Brazil in the 1990s: the impact of changes in patterns of drug use. *J Acquir Immune Defic Syndr*. 2001;28(3):298–302.
8. Inciardi JA. In: Monteiro MG, Inciardi JA, editors. *Brazil-United States. Binational Research*. São Paulo: CEBRID – Centro Brasileiro de Informações sobre Drogas Psicotrópicas; 1993. p. 63–75.
9. Plano integrado de enfrentamento ao crack e outras drogas (Integrated plan for dealing with crack and other drugs. 2010. Available in: [http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Decreto/D7179.htm] (accessed in December 20, 2019)
10. Fischer B, Cruz MS, Bastos FI & Tyndall M. Crack across the Americas – a massive problem in continued search of viable answers: exemplar views from the North (Canada) and the South (Brazil). *International Journal of Drug Police*. 2013;24(6): 631-3.
11. Ribeiro LA, Sanchez ZM, Nappo SA. Surviving crack: a qualitative study of the strategies and tactics developed by Brazilian users to deal with the risks associated. *BMC Public Health*. 2010;10:671.
12. Gonçalves JR, Nappo SA. Factors that lead to the use of crack cocaine in combination with marijuana in Brazil: a qualitative study. *BMC Public Health* 2015;15:706.
13. Chaves TV, Sanchez ZM, Ribeiro LA, Nappo SA. Crack cocaine craving: behaviors and coping strategies among current and former users. *Rev Saude Publica*. 2011;45(6):1168–75.
14. FIOCRUZ- Oswaldo Cruz Foundation –2012. National Survey on the Crack Cocaine Use. Available in: [<https://programadrogas.fiocruz.br/publicacoes/livros/51>] (accessed in November 15, 2019).
15. Wiseman EJ, Mc Millan DE. Combined use of cocaine with alcohol, cigarettes. *Am J Drug Alcohol abuse*. 1996;22(4):577-587.

16. Magura S, Rosenblum A. modulating effect of alcohol use or cocaine use. *Addict Behav.* 2000;25:117-22.
17. Brache K, Stockwell T, Macdonald S. Functions and harms associated with simultaneous polysubstance use involving alcohol and cocaine. *Journal of Substance Use.* 2012;17(5–6):399–416.
18. WHO - World Health Organization. Global Status Report on Alcohol and Health: 2014. Available in: [http://www.who.int/substance_abuse/publications/global_alcohol_report/en/] (accessed in November 3, 2019).
19. II LENAD (II National Survey of Alcohol and Drugs), 2014. Available in: [<http://inpad.org.br/lenad/>] (accessed in November 4, 2019).
20. WHO - World Health Organization. Qualitative research for health programs. Geneva: Division of Mental Health; 1994._
21. Taylor SJ, Bogdan R. Introduction to Qualitative Research Methods. New York: John Wiley & Sons Inc; 1998. Patton M. Qualitative research and evaluation methods. 3rd ed. Thousand Oaks: Sage Publications; 2002.
22. Kvale S. InterViews: an introduction to qualitative research interviewing. Thousand Oaks: Sage Publications; 1996.
23. Creswell JW: Research design: Qualitative, quantitative and mixed methods approaches. 3rd edition: London: Sage Publications; 2009.
24. Siegel RK. Cocaine smoking. *J Psychoactive Drugs.* 1982;4(4):271–359.
25. Biernacki P, Waldorf D. Snowball sampling: problems and techniques of chain referral sampling. *Sociol Methods Res.* 1981;10(2):141–63. ABEP (Associação Brasileira de Empresas e Pesquisa). Critério de Classificação Econômica Brasil. 2012.
26. DSM: Diagnostic and Statistical Manual of Mental Disorders. 4th edition. Washington DC: American Psychiatric Publishing; 2000.
27. Bardin L. Análise de Conteúdo, vol. 70. 3rd ed. Lisboa: Edições; 2004
28. NVivo qualitative data analysis Software; 2012 QSR International Pty Ltd. Victoria Australia. Version 10. Available in: <http://helpv10.qsrinternational.com/desktop/welcome/welcome.htm>. Accessed in May 26, 2017.
29. Haasen C, Krausz M. Myths versus evidence with respect to cocaine and crack: learning from the US experience. *Eur Addict Res.* 2001;7(4):159-60.
30. Amlung MT, Morris DH, and McCarthy DM. Effects of Acute Alcohol Tolerance on Perceptions of Danger and Willingness to Drive after Drinking. *Psychopharmacology (Berl).* 2014;231(22):4271–4279.
31. Livingston JA, Testa M, Windle M, Bay-Cheng LY. Sexual risk at first coitus: Does alcohol make a difference? *J Adolesc.* 2015;43:148-58.
32. Lau-Barraco C, Schmitz JM. Drug Preference in cocaine and alcohol dual-dependent patients. *The American Journal of Drug and Alcohol Abuse.* 2008; 34:211-217.

33. Fox HC, Talih M, Malison R, Anderson GM, Kreek MJ, Sinha R. Frequency of recent cocaine and alcohol use affects drug craving and associated responses to stress and drug –related cues. *Psychoneuroendocrinology*. 2005;30:880-891.
34. Heil SH, Badger GJ, Higgins ST. Alcohol dependence among cocaine-dependent outpatients: demographics, drug use, treatment outcome and other characteristics. *J Stud Alcohol*. 2001;62:14–22.
35. Gossop M, Manning V, Ridge G. Concurrent use and order of use of cocaine and alcohol: behavioural differences between users of crack cocaine and cocaine powder. *Addiction*. 2006;101:1292-1298.
36. Antoniazzi RP, Sari AR, Casarin M, Moraes CMB, Feldens AA. Association between crack cocaine use and reduced salivary flow. *Braz Oral Res*. 2017; 31:e42.
37. Woyceichoski IEC, Costa CH, Araujo CM, Brancher JA, Resende LG, Vieira I, Lima AAS. Salivary buffer capacity, pH, and stimulated flow rate of crack cocaine users. *Journal of Investigative and Clinical Dentistry*. 2013;4:160–163.
38. Knacksted LA, Ben-Shahar O., Ettenberg A. Alcohol consumption is preferred to water in rats pretreated with intravenous cocaine. *Pharmacology, Biochemistry and Behavior*. 2006;85:281-286.
39. McCance E. F., Price L. H., Kosten T. R., Jatlow P. I. Cocaine: pharmacology, physiology and behavioural effects in humans. *J Pharmacol Exp Ther* 1995;**274**: 215–23.
40. Pan W. J., Hedaya M. A. Cocaine and alcohol interactions in the rat: contribution of cocaine metabolites to the pharmacological effects. *J Pharmacol Sci* 1999;**88**: 468–76.
41. Graziani M, Nencini P, Nistico R. Gender and concurrent use of cocaine and alcohol: Pharmacological aspects. *Pharmacological Research*. 2014; 87:60-70.
42. Bunney EB, Appel SB, Brodie MS. Cocaine potentiates ethanol-induced excitation of dopaminergic reward neurons in the ventral tegmental area. *Journal of Pharmacology and Experimental Therapeutic* 2000; 293(2);383-389.
43. Borges G, Cherpitel C, Orozco R, MasDonald S, Giesbrecht N, Moskalewics J, Swiatkiewicz G, Cremonese M. Alcohol as a trigger for medical emergencies. *Subst Use Misuse*. 2013;48(7):484-489, 2013.
44. Zerhouni O, Begue L, Brousse G, Carpentier F, Dematteis M, Pennel L, Swendsen J, Cherpitel C. Alcohol and violence in the emergency room: a review and perspectives from psychological and social sciences. *Int J Environ Res Public Health*. 2013;10(10):4584-4606.
45. Salloum IM, Daley DC, Cornelius JR, Kirisci L, Thase ME. Disproportionate lethality in psychiatric patients with concurrent alcohol and cocaine abuse. *Am J Psychiatry* 1996;153:953–5.
46. Pennings EJM, Leccese AP, de Wolff FA. Effects of concurrent use of alcohol and cocaine. *Addiction*. 2002;97(7), 773–783.
47. Marks KR, Pike E, Stoops WW, Rush CR. Alcohol administration increases cocaine craving but not cocaine cue attentional bias. *Alcohol Clin Exp Res*. 2015; 39(9),1823-1831.
48. McKay JR, Alterman AI, Rutherford MJ, Cacciola JS, McLellan AT. The relationship of alcohol use to cocaine relapse in cocaine dependent patients in an aftercare study. *J Stud Alcohol*. 1999;60:176-180.

49. Rubio G, Manzanares J, Jiménez M, Rodríguez-Jiménez R, Martínez I, Iribar-ren MM, et al. Use of cocaine by heavy drinkers increases vulnerability to developing alcohol dependence: a 4-year follow-up study. *J Clin Psychiatry*. 2008;69:563–70.
50. Regier DA, Farmer ME, Rae DS, Lacke BZ, Keith SJ, Judd LL, Goodwin FK. Comorbidity of Mental disorders with Alcohol and other Drug Abuse. Results from the Epidemiologic catchment Area (ECA) study. *Jama*. 1990;264(19):2511-18.
51. Carroll KM, Rounsaville BJ and Bryant KJ. Alcoholism in treatment-seeking cocaine abusers: Clinical and prognostic significance. *J. Stud. Alcohol*. 1993; 54:199-208.
52. Higgins ST, Budney AJ, Bickel WK, Foerg FE, and Badger GJ. Alcohol dependence and simultaneous cocaine and alcohol use in cocaine-dependent patients. *J. Addict. Dis*. 1994;13:177-189.
53. Ahmadi J, Kampman KM, Oslin DM, Pettinati HM, Dackis C, Sparkman T. Predictors of treatment Outcome in Outpatient Cocaine and Alcohol Dependence treatment. *Am J Addict*. 2009;18(1):81-86.
54. Brady KT, Sonne E, Randall CL, Adinoff B, Malcon R. Features of cocaine dependence with concurrent alcohol use. *Drug Alcohol Depend*. 1995;39:69-7.
55. Laizure SC, Parker RB. Pharmacodynamic evaluation of the cardiovascular effects after the coadministration of cocaine and ethanol. *Drug Metab Dispos*. 2009;37(2):310–314.
56. Wilson LD, Jeromin J, Garvey L, Dorbandt A. Cocaine, ethanol, and cocaethylene cardiotoxicity in an animal model of cocaine and ethanol abuse. *Acad Emerg Med*. 2001;8:211–22.
57. Bailey DN. Plasma cocaethylene concentrations in patients treated in the emergency room or trauma unit. *Am J Clin Pathol*. 1993;99:123–7.
58. Foltin RW, Fischman MW. Ethanol and cocaine interactions in humans: cardiovascular consequences. *Pharmacol Biochem Behav* 1998; 31: 877–83.
59. Lucena J, Blanco M, Jurado C, Rico A, Salguero M, Vazquez R, Thiene G, Basso C. Cocaine-related sudden death: a prospective investigation in south-west Spain. *Eur Heart J*. 2010;31(3):318-29.

Sustainability or Health: Why Brazilian Consumers Buy Organic Food?

Edmilson Pinto de Albuquerque, MSc

Dept. of Administration, Faculty Ateneu,
Fortaleza-CE, Brazil.

José Carlos Lázaro da Silva Filho, Prof. Dr.

Post-Graduation Program on Management and Controlling (PPAC), Federal University of Ceará,
Fortaleza-CE, Brazil.

Josimar Souza Costa, Prof. (Corresponding author)

Communication and Management Sciences Center, University of Fortaleza,
Fortaleza-CE, Brazil.

Sandra Maria Santos, Prof.

Post-Graduation Program on Management and Controlling (PPAC), Federal University of Ceará,
Fortaleza-CE, Brazil.

Abstract

This research investigated environmental awareness aspects and the behaviour involving search for health in an attempt to find their influence on consumers' intention to purchase organic food (OF), namely organic fruits and greens (OFGs), in Fortaleza, a Brazilian Northeastern metropolis. The quantitative analysis herein presented is based on a sample survey which involved 200 organic food consumers. The data was submitted to Structural Equation Modelling (SEM) in the light of the Theory of Planned Behaviour. A general OF buyer sample led to the conclusion that purchase behaviour is influenced by factors related to beliefs concerning search for health, not to environmental awareness. It also bring to light an important issue regarding the profile of organic food buyers in Brazil revealing the link to health issues which might be explored by marketing actions, they also indicate the need for more discussion with general public about environmental impacts caused by food production.

Keywords: Organic Food, fruits and greens; Brazil; Purchase intention; Health; Environmental concern.

Funding: This work was supported by the Brazilian Agencies CAPES and CNPq.

Introduction

The global market for organic food (OF) has been growing since the middle of the 1990s. A specific part of this market, comprised by non-processed fruits, vegetables and greens (OFG), represents about 45% of sales (Winter & Davis, 2006). The world market revenue for certified OFGs was estimated at USD 59.1

billion in 2010 (Willer & Kilcher, 2012). According to the 2015's report of Research and Markets, the global market continues to grow at a rate of 9.4% in 2015 with an increasing OFG consumption, being expected to reach about USD 63 billion by 2020. One of the main points of this projection is the role of emerging markets, such as India, China and Brazil (Global Organic Trade, 2015).

Some authors observed that the food supply crisis and growing concerns over the use of pesticides in agriculture have started to shake consumers' beliefs in processed food, resulting in a demand for healthier options (Portilho, Castaneda & Castro, 2011; Shaharudin; Mansor & Elias, 2010; and Chen, 2007). On the other hand, the institutionalized concept of Organic Food brings a common assertion about its production. Thus, organic agriculture is believed to use organic rather than synthetic fertilizers, avoiding pesticides and other agrochemicals, also antibiotics and hormones, as in animal husbandry. It may be defined as an ecological production and management system, favouring biodiversity, biological cycles and biological soil activity (Winter & Davis, 2006; Schafer et al., 2009; Paul & Rana, 2012, Beharrell & MacFie, 1991). Therefore, the organic food consumption growth could be understood as both healthy and ecologically friendly. In the market perspective, since the 1990s, it has become relevant to investigate these consumers' profiles, their values, beliefs and attitudes in relation to intention and behaviour (Werner & Alvensleben, 1984; Beharrell & MacFie, 1991; Davies et al., 1995; Schifferstein & Oude Ophuis, 1998; Zanolli & Naspetti, 2002; Chen, 2007 & 2009).

According to Magnusson *et al.* (2003), the association of organic foods with health and environment allows the identification of two consumer profiles. The egoistic profile is based on personal health as the main motivation factor, whereas the altruist is focused on environmental preservation and food supply for future generations (Magnusson *et al.*, 2003). Therefore, the growing interest in OF may be associated with both altruism and egoism factors. On the one hand, there are ethical concerns over environmentally friendly production methods (including the well-being of the workers involved); on the other hand, consumer health is focused to the detriment of the environmental perspective (Gil; Gracia; Sanchez, 2000; Baker *et al.*, 2004; Özcelik & Uçar, 2008, Cerjak et al. 2010). Guillon and Willequet (2003), as well as Guivant (2003), polarize the issue by stating that consumers seeking health, self-confidence, and cosmetic benefits are on an "ego trip", whereas consumers systematically purchasing OFG in support of a social environmental agenda are on an "eco trip". Nevertheless, this research does not aim to identify profiles, remaining this issue as research background.

The consumers' OF profile, mostly based on demography, lifestyle and purchase behaviour, has been the object of studies in European countries since the last decades of the twentieth century, as mentioned by Baker et al. (2004) (see also Schifferstein & Oude Ophius, 1998; Gil Garcia & Sanchez, 2000; Tsakiridou et al., 2008; Essoussi & Zahaf, 2009).

Besides the consumer profile, other studies sought to understand the motivations to the organic food purchase. Most of them used a chain construct of a rational action, which is derived from the Theory of Rational Action (TRA) and its improved version, the Theory of Planned Behaviour (TPB), proposed by Ajzen (1991). In doing so, they tried to measure values, beliefs, attitude, intention, and a final behaviour (purchase).

TPB has previously been used in studies on organic food consumption to verify the existence of possible positive associations between perceived behavioural control, the intention to buy, and the actual purchase

of such foods (Chen, 2007; Thøgersen, 2006, Aertsens et al, 2009;). The cognitive and affective components which influence the intention to buy OF should, therefore, be taken into account when investigating consumer behaviour (Dean; Raats & Shepherd, 2008).

Brazilian authors have also employed TPB, but very few have applied it to the investigation of OF consumption. For example, Santos, Veiga and Moura (2010) applied TPB to the field of technological services. Hoppe et al. (2012) surveyed the profile of organic food consumers at ecological fairs and supermarkets, partly replicating the methodology adopted in the EU-funded CONDOR project (Consumer Decision Making on Organic Products) in which TPB and Personal Value Theory were used to explore the values, attitudes and affective components believed to determine organic food consumer behaviours. Rodrigues, Carlos, Mendonça and Correa (2009), in light of TPB, surveyed supermarket customers in Ribeirão Preto, a Brazilian South-east town, and found that the decision to buy OFGs was mainly the result of egoistic factors.

Hitherto, studies have found a range of motivations to the organic food purchase. Besides being healthier and environmentally friendly, it tastes better, is made of natural content only (without genetic modified substances, chemicals or hormones), and uses local content (Lockie et al., 2002; Cerjak et al., 2010; Chen, 2007 & 2009; Hughner et al., 2007; Tsakiridou et al., 2008; Aertsens et al., 2011; Nasir & Karakaya, 2014; Nedra et al., 2015).

Nevertheless, most of the international published researches about purchasing are from markets in developed, industrialized countries (Schifferstein & Oude Ophuis, 1998; Baker et al., 2004; Tarkiainen & Sundqvist, 2005; Onyango et al., 2007; Essoussi & Zahaf, 2009; Aertsens et al., 2009; Shafie & Rennie, 2012). There are some studies in developing countries (Paul & Rana, 2012; Hoppe et al., 2013; Nedra et al., 2015; Xie et al., 2015 Yazdanpanah & Forouzani, 2015; Thøgersen et al., 2015), but despite them, this research field still has a gap in the understanding of the rationality chain from the motivation to the purchase behaviour in these regions.

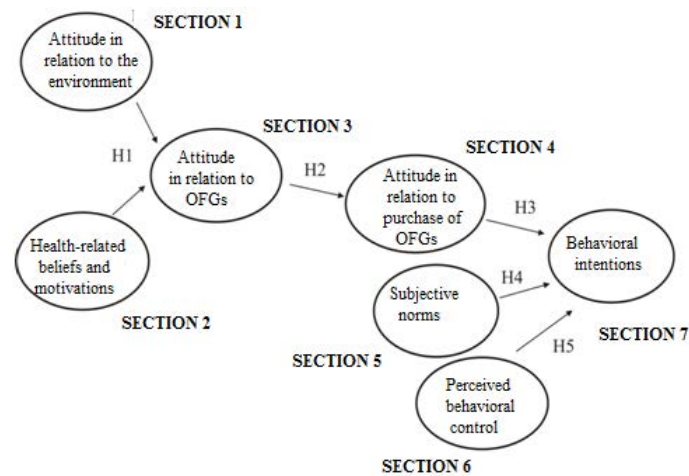
This study followed the research design of Chen (2007) in order to understand this purchase rational chain by means of constructs, such as attitudes, intentions, and behaviours. It presents the two main attitudinal motivations in the literature, namely health beliefs and ecological awareness, which could compose the attitudes towards organic food, conducting the investigation in the light of the Theory of Planned Behaviour (Ajzen, 1991 & 2001; Ajzen & Fishbein, 2008). Despite the criticism about the behaviour rationality in the TPB, this theory has been used in other studies concerning this theme (Chen, 2007; Dean et al., 2008; Hoppe et al., 2012; Nasir & Karakaya, 2014; Lee & Yun, 2015; Hsu et al., 2016). Thus, it was considered a valuable approach for the purposes established herein.

The purpose of the present study was to understand the consumers' purchase behaviour in Fortaleza, a Brazilian metropolis in the Northeast Brazil, featuring elements which characterize it as an underdeveloped region of a developing country. Such understanding was sought by means of a rational chain, starting from the beliefs in environmental awareness and healthy lifestyle, the two main motivations according to international researches.

Based on a study by Chen (2007), and in view of the aforementioned considerations regarding food consumer profiles and TPB, it was decided to investigate the relation between health and environment

constructs and OF consumption. Figure 1 shows the conceptual framework adopted in the present study and the relations between the constructs.

Figure 1: Conceptual framework and the proposed relations among TPB constructs.



Source: the authors based on a study by Chen 2007]

The following hypotheses were formulated:

H1a: Attitude towards the environment (ATEN) is related to attitudes towards organic food (ATOF);

H1b: Health-related beliefs (HRBM) are related to attitudes towards organic food (ATOF);

H2: Attitude towards organic food (ATOF) is related to attitudes towards the purchase of organic food (ATPU);

H3: Attitudes towards the purchase of organic food (ATPU) influence the behaviour/purchase intention towards organic food (BINT).

H4: Subjective norms (SNRM) influence behaviour/purchase intention towards organic food (BINT);

H5: Perceived behavioural control (PCTR) influences behaviour/purchase intention towards organic food (BINT).

After this introduction follow the sections presenting methods, calculation, results and discussion. In the end, conclusions are presented, as well as final considerations regarding the academic and managerial implications of the study.

2. Material and methods

The first definition of the research design led to the choice of a specific kind of organic food. In order to better identify the consumer that was purchasing OF at the retail site, it was decided to study the purchase of Organic Fruits and Greens. The OFGs used to be quoted in the literature as a more explicit organic food (Winter & Davis, 2006; Dean et al., 2008; Thøgersen et al., 2015), and represent about 45% of the total OF market (Willer & Kilcher, 2012). Moreover, the OFG purchase is a final behaviour confirmed by the prior identification of the respondent.

Based on questionnaires previously used in similar studies, the instrument of this study comprised nine sections, seven of them designed directly aligned to the TPB. The eighth and ninth sections collected

information on purchase frequency and socio-demographic profile, respectively. Most of the questionnaire items were scored on a seven-point Likert scale. Table 1 shows the construct/parameter evaluated in each section.

Table 1: Overview of the nine sections in the questionnaire.

Section	Construct/parameter	Code	Number of questions	Reference	Objective
1	Beliefs & Attitude in relation to the environment	ATEN	05	Gil; Gracia; Sanchez (2000)	To measure beliefs and attitudes in relation to the construct “environmental awareness”
2	Health-related beliefs and motivations	HRBM	09	Chen (2007); Schifferstein & Oude Ophuis (1998)	To measure beliefs and attitudes in relation to the construct “health seeking behaviour”
3	Attitude in relation to OFGs	ATOF	09	Gil; Gracia; Sanchez (2000)	To measure beliefs and attitudes in relation to the construct “organic foods”
4	Attitude in relation to purchase of OFGs	ATPU	06	Hoppe et al, (2010)	To measure beliefs, attitudes and moral judgments in relation to the construct “purchase of OFGs”
5	Subjective norms	SNRM	02	Chen (2007)	To measure the social factors influencing intentions.
6	Perceived behavioural control	PCTR	03		To measure predictors of actual control and perceived barriers.
7	Behavioural intentions	BINT	02	Shaharudin <i>et al</i> (2010)	To measure behavioural expectations of respondents in relation to purchase.
8	OFG purchase frequency	-	04	The authors	To quantify purchase frequency
9	Socio-demographic profile	-	07	The authors	To draw a consumer profile.

Source: the authors.

The questionnaire was applied to a pilot sample of about 30 scholars from the Federal University of Ceará, from different areas (Engineering, Social Sciences, etc.). The initial question, which investigated the actual OFG purchase, was reinforced. The high education level of this sample might suggest some bias, but it confirmed the fitting of the questionnaire. The pre-test contributed to the research, among other advantages, to determine how long the respondents would need to take to complete the survey (Hair Jr et al., 2010), and to verify the proper comprehension of the questions (Malhotra, 2012). In order to facilitate

the survey process, each question block (representing a scale) was presented separately to the respondents right in the pre-test phase. The average response time in this pre-test stage was 10 minutes per respondent. In order to run the sample, it was hired a market research group which had to perform 200 valid questionnaires. One of the authors supervised the field researchers daily. Therefore, the questionnaire was administered to 200 customers at two types of OFG retail sites in Fortaleza, involving 16 supermarkets (previously authorized) and an agro-ecological fair (at the time, the only one in the city). Even after a visual identification of the OFG purchase, the respondents were screened with a filter question confirming that they purchased OFG.

TPB assumes that behaviours may be predicted, albeit imperfectly, based on a combination of attitudes, subjective norms and perceived behavioural control. The combination of study constructs allowed a meaningful interpretation of the data. Thus, Structural Equation Modelling (SEM) was chosen to analyse the multiple relationships between the dependent and independent variables of the conceptual framework. For this purpose, the questionnaire data were submitted to multivariate statistical analysis, using the software SPSS and AMOS, v. 20.0.

3. Theory and Calculation

SEM is a multivariate analysis technique which combines aspects of multiple regression (evaluating dependent relationships) and factor analysis in order to simultaneously estimate series of dependent relationships (Hair et al, 2005). The expression “structural equation” derives from relationship models between independent and dependent latent variables (Lattin; Carro & Green, 2011).

In SEM, the evaluation of the proposed model requires fitting the study parameters and the model in general. Table 2 shows three types of fitting reference values to different indexes: i) absolute fit indexes, indicating the general fit of the model, ii) comparative fit indexes, in which the fit is verified by comparing the chosen model to a more restrictive one (basic or null model), and iii) parsimonious fit indexes, determining the number of study parameters required to attain a particular level of fit while avoiding over-fitting model (Hair Jr et al., 2005).

Table 2: Model fit indices

Type	Index	Reference values	
Absolute fit measures	CMIM (Chi-square)	Not defined	
	Degrees of freedom (DF)	≥ 1	
	CMIN/DF (χ^2/GL)	<5	
	Goodness-of-Fit Index (GFI)	>0.90	
	Adjusted Goodness-of-Fit Index (AGFI)	>0.80	
Comparative (incremental) fit measures	Comparative Fit Index (CFI)	0.90	
	Normed Fit Index (NFI)	>0.90	
	Tucker Lewis Index (TLI)	>0.90	
Parsimonious fit measures	Root Mean Square Error of Approximation (RMSEA)	Good fit	Acceptable fit
		0.00 < RMSEA < 0.05	0.05 < RMSEA < 0.08

Source: the authors, based on Silva (2006), Hoppe et al.(2010) and Hair Jr et al.(2005).

It is assumed that the quality of the results produced from a structural equation model depends on the quality of the preliminary model fit in relation to the data set. The overall model fit is tested by a set of indices (including RMSEA and AGFI) rather than by a single best index; in other words, a combination of indices should be used (Silva, 2006; Hair Jr *et al*, 2005). In addition to the analysis of these indices, the reliability and the variance extracted from each construct were determined in order to accurately assess the one-dimensional and convergent validity of the model.

4. Results

4.1. Socio-demographic description of the study sample

Women were predominant in the sample, corresponding to 136 respondents (68%), whereas men were in number of 64 (32%). When the sample was stratified by age group, the first three groups were almost equally represented: 18-25 years (18%), 26-35 years (19%) and 36-45 years (18.5%). The fourth group (46-55 years) was the largest (n=52; 26%). The fifth group (56-65 years) and the sixth group (>65 years) were represented by 27 (13.5%) and 10 (5%) consumers. Most respondents claimed to have college degree.

Family income also varied in the sample. Five income groups were considered: BRL $\leq 1,000$ (approx. USD ≤ 400), BRL 1,001 - 3,000 (approx. USD 400 - 1,200), BRL 3,001 - 5,000 (approx. USD 1,200 - 2,000), BRL 5,001 - 7,000 (approx. USD 2,000 - 2,900), and >BRL 7,000 (approx. USD 2,900). The third income group (BRL 3,001 - 5,000) was predominant in the sample (29%), followed by the last group (25.5%), the second group (17%), the fourth group (15.5%), and the first group (13%).

Regarding the type of retail site, more respondents were interviewed at supermarkets (87.5%) than at the agro-ecological fair.

4.2 Descriptive analysis of TPB constructs

Table 3 shows the constructs analysed in the study and their respective observable indicators, mean values, and standard deviations. The highest mean values were found to the following indicators: "It is important that my daily diet keeps me healthy" (6.70) and "I think it is important to know how to eat in a healthy way" (6.67), both related to the construct HRBM. As for the construct ATEN, the highest mean values were found to the following indicators: "Development is destroying the environment" (6.25) and "Unless something is done, environmental damage will be irreversible" (6.38).

There was considerable agreement among the respondents regarding the statement that OFGs are healthy, as shown by the average scores obtained to *atof1* (6.63) and *atof2* (6.34).

Table 3: Descriptive statistics of TPB constructs and their respective indicators.

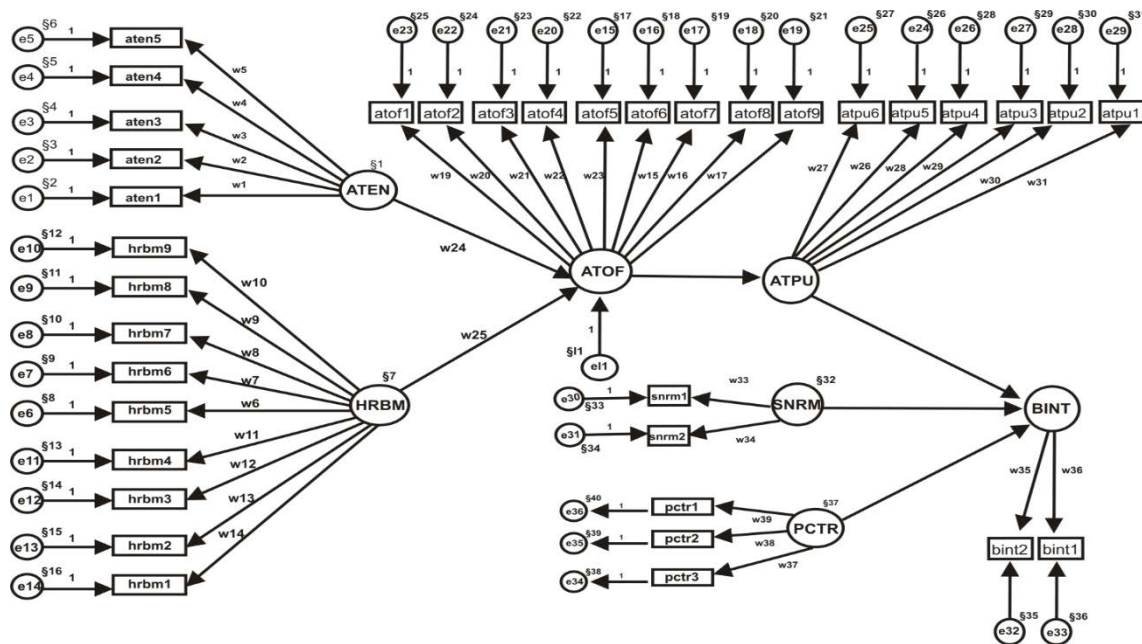
Construct	Observable indicators (code)	Mean	S.D.
ATEN	Development is destroying the environment (aten1)	6.25	1.34
	I prefer to buy recycled products (aten2)	5.12	1.75
	I sort my waste (aten3)	4.75	2.25
	Unless something is done, environmental damage will be irreversible (aten4)	6.38	1.35
	I actively help preserve the environment (aten5)	5.26	1.63
HRBM	It is important that my daily diet keep me healthy (hrbm1)	6.70	0.81
	I do not think all the time whether everything I do is healthy (hrbm2)	4.57	2.05
	It is important that my daily food be nutritious (hrbm3)	6.48	1.12
	It is important that my daily food benefit my skin, teeth and hair (hrbm4)	6.24	1.33
	I think it is important to know how to eat in a healthy way (hrbm5)	6.67	0.74
	I have the impression other people are more health-aware than me (hrbm6)	3.88	2.18
	I do not wonder all the time whether the food I eat is good for me (hrbm7)	4.22	2.10
	I think I sacrifice a lot for the sake of my health (hrbm8)	3.27	1.90
	I am willing to abstain from a lot of foods and eat in the healthiest possible way (hrbm9)	5.38	1.72
ATOF	Organic foods are healthier (atof1)	6.63	0.85
	Organic foods are of better quality (atof2)	6.34	1.11
	Organic foods are a hoax (atof3)	1.84	1.38
	Organic foods are tastier (atof4)	5.11	1.91
	Organic foods are worse than non-organic foods (atof5)	1.80	1.51
	Organic foods are more expensive (atof6)	6.50	1.12
	Organic foods look more attractive (atof7)	5.17	2.01
	Organic foods cause no harm (atof8)	5.59	1.76
	Organic foods are a fad (atof9)	2.04	1.54
ATPU	Buying OFGs rather than non-organic foods makes me feel “politically correct” (atpu1)	5.72	1.76
	Buying OFGs rather than non-organic foods makes me feel a better person (atpu2)	5.32	2.04
	Buying OFGs rather than non-organic foods makes me feel I am making an important contribution (atpu3)	6.03	1.46
	Buying OFGs rather than non-organic foods would be... (atpu4)	6.57	0.90
	Buying OFGs rather than non-organic foods would be... (atpu5)	6.50	0.93
	Buying OFGs rather than non-organic foods would make me feel... (atpu6)	6.41	1.09
SNRM	Most of the people who are important to me think I should _____ OFGs (snrm1)	5.67	1.70
	Many of the people close to me think I should _____ OFGs (snrm2)	5.66	1.62
PCTR	If OFGs were sold at the stores, nothing would prevent me from buying them if I felt like it (pctr1)	5.85	1.46
	I have control over occasional purchases of OFGs (pctr2)	5.45	2.02
	If I wanted to, I could easily buy OFGs instead of non-organic foods (pctr3)	5.03	2.09
BINT	I plan to buy OFGs sometime soon (bint1)	6.14	1.23
	I plan to buy OFGs within the next two weeks (bint2)	5.64	1.83

Source: Data collected for the study in 7 points Likert scales

4.3 Fitting of the proposed model

The conceptual framework shown in Figure 1 was expressed in the form of a path diagram and named “Model 1” (Figure 2). According to Hair Jr *et al.* (2005), a path diagram is not only a visual description of predictive relations between constructs (relations between dependent and independent variables), but also of associative relations (correlations) between constructs or even indicators.

Figure 2: Model 1. Path diagram of the conceptual framework (from AMOS).



Source: The authors. The indices based on Model 1 (Figure 2) are listed in Table 4.

As shown in the diagram, the constructs ATEN (attitude in relation to the environment), HRBM (health-related beliefs and motivations), SNRM (subjective norms) and PCTR (perceived behavioural control) are exogenous, while ATOF (attitude in relation to OFGs) and ATPU (attitude in relation to purchase of OFGs) are endogenous. The indexes based on Model 1 (Figure 2) are listed in Table 4.

Table 4: Model fit indices for Model 1.

Index	CMIN/DF	RMSEA	PCLOSE	GFI	AGFI	CFI	TLI	NFI	P
Reference	< 5	0.05-0.08	>0.05	>0.90	>0.80	>0.80	>0.90	>0.90	0.05-0.10
Study	1.91	0.08	0.00	0.76	0.72	0.74	0.72	0.59	0.00

Source: Data collected for the study

The combination of test indexes used to fit the sample proposed model yielded poor results. To improve the fitting, therefore, the model was redesigned in an attempt to find robust significant correlations.

4.4 A fitting Model

In the second model, some of the constructs were correlated at the 5% level of significance ($p < 0.05$). Not all estimates (ATEN, SNRM and PCTR) were significant because their C.R. values did not fit the desired parameter ($> |1.96|$), indicating that the hypotheses regarding these constructs should be rejected.

Furthermore, in the redesigned model, ATEN not only did not have any positive influence on ATOF, but in fact had a negative weight, a finding which justifies rejecting the H1a. Likewise, SNRM and PCTR failed to significantly impact the intention related to OFG purchase. Thus, H4 and H5 were also rejected.

The constructs ATEN, SNRM and PCTR were subsequently removed from the model. The fit of the final model was good, as shown in Figure 3. This was the best model of the conceptual framework based on TPB.

Figure 3: Model 2. Path diagram of the conceptual framework.

Source: Data collected for the study.

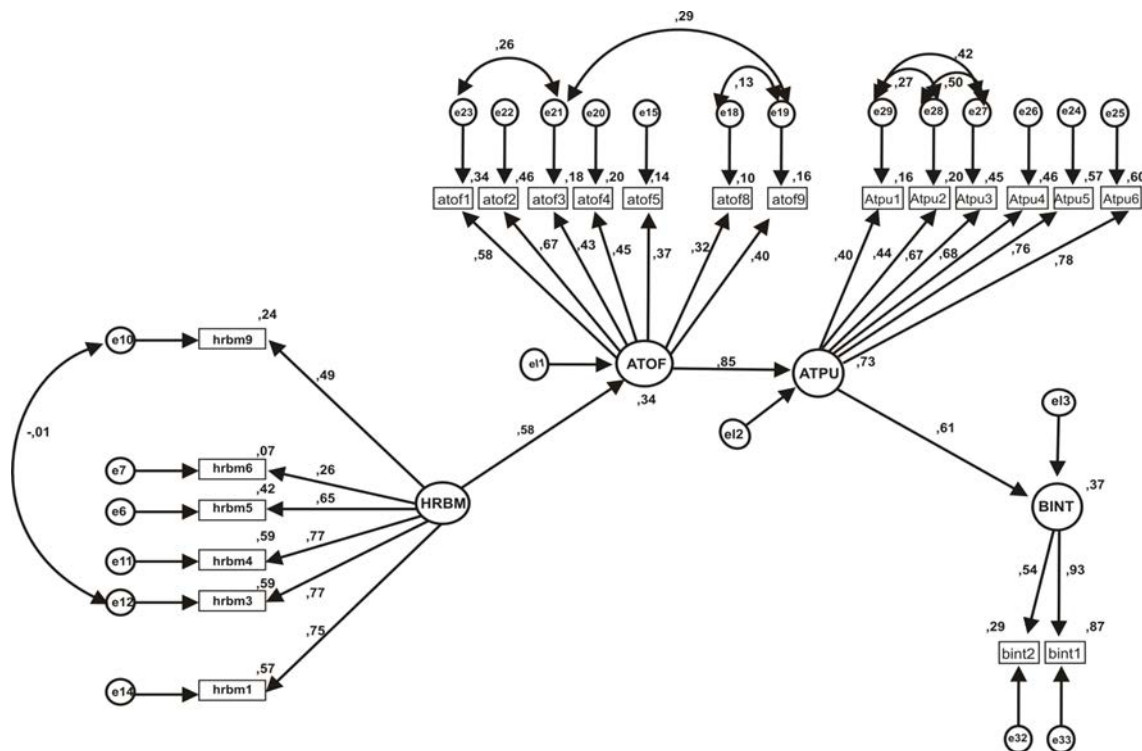


Table 5 shows the model fit for the final model.

Table 5: Model fit indices for the final model.

Index	CMIN/DF	RMSEA	PCLOSE	GFI	AGFI	CFI	TLI	NFI	P
Reference	< 5	0.05-0.08	>0.05	>0.90	>0.80	>0.80	>0.90	>0.90	0.05-0.10
Study	1.77	0.06	0.04	0.87	0.83	0.89	0.88	0.79	0.00

Source: Data collected for the study.

Regarding the absolute fit measures, the value of GFI (0.87) was fitted to the recommended standards. RMSEA was fitted to the desired parameters (1.77), indicating that the constructs were appropriately fitted to the study population. The incremental fit measures (NFI, CFI and TLI) used to compare the final model

to the null model were also slightly fitted. The ratio between χ^2 and degrees of freedom, which should be under 5, was appropriately fitted (1.76).

The diagram of the final model shows that ATOF exerts a strong and direct influence (0.85) on ATPU. HRBM produces a smaller but relevant impact (0.58) on ATOF. In the study sample, ATPU had a positive and slightly stronger influence (0.61) on buying intention. The analysis of the estimates for the parameters, including the regression weights of the final model, is presented in Table 6.

Table 6: Regression weights standardized for the final model

		Construct	Estimates	Standardized estimates	S.E.	C.R.	P
ATOF	<---	HRBM	.333	0.584	.059	5.647	***
ATPU	<---	ATOF	1.219	0.853	.188	6.483	***
BINT	<---	ATPU	.999	0.612	.137	7.273	***
hrbm5	<---	HRBM	.553	0.647	.065	8.516	***
hrbm6_mod	<---	HRBM	.649	0.256	.193	3.355	***
hrbm9	<---	HRBM	.977	0.489	.151	6.455	***
hrbm4	<---	HRBM	1.190	0.769	.115	10.369	***
hrbm3	<---	HRBM	1.000	0.769			
hrbm1	<---	HRBM	.711	0.753	.070	10.138	***
atof8	<---	ATOF	1.144	0.320	.304	3.759	***
atof9_mod	<---	ATOF	1.256	0.400	.273	4.596	***
atof4	<---	ATOF	1.743	0.449	.350	4.985	***
atof5_mod	<---	ATOF	1.139	0.372	.268	4.252	***
atpu5	<---	ATPU	1.000	0.756			
atpu6	<---	ATPU	1.205	0.777	.120	10.050	***
atpu4	<---	ATPU	.872	0.682	.095	9.211	***
atpu3	<---	ATPU	1.405	0.674	.150	9.340	***
atpu2	<---	ATPU	1.289	0.445	.219	5.877	***
atpu1	<---	ATPU	.994	0.398	.188	5.287	***
bint2	<---	BINT	.869	0.543	.174	4.980	***
bint1	<---	BINT	1.000	0.933			
atof_3_mod	<---	ATOF	1.194	0.427	.214	5.577	***
atof1	<---	ATOF	1.000	0.580			
atof2	<---	ATOF	1.517	0.675	.215	7.044	***

Source: Data collected for the study. *** $p < 0.001$ (significant)

In Table 6, the P values are significant for all constructs since the C.R. values are well above the reference value ($> |1.96|$). Thus, the final model was fitted with different index combinations. It should be added that the study findings indicate a correlation between several pairs of indicators in the general model (such as

atof1/atof3, atof3/atof9, atof8/atof9, atpu1/atpu2, atpu2/atpu3, and atpu1/atpu3). Thus, the addition of covariance between the errors of these two indicators would lead to a significant improvement. The insertion of such covariance significantly improved the fit of the final model and the fit indexes, as shown in Table 5 comparing to Table 4. In other words, based on the final fitted model (Figure 3), some of the study hypotheses were rejected while others were accepted (Table 7).

Table 7: Study hypotheses and results.

Hypothesis	Relation	Standardized factor load	T-value	Result
H1a: Environmental awareness influence attitudes in relation to OFGs.	ATEN/ATOF	-	-	Rejected
H1b: A “health seeking” behaviour influences attitudes in relation to OFGs.	HRBM/ATOF	0.584	(5.647)	Accepted
H2: Attitudes in relation to OFGs influence attitudes in relation to the purchase of OFGs.	ATOF/ATPU	0.853	(6.483)	Accepted
H3: Attitudes in relation to the purchase of OFGs influence consumers’ intention to buy OFGs.	ATPU/BINT	0.612	(7.273)	Accepted
H4: Subjective norms influence consumers’ intention to buy OFGs.	SNRM/BINT	-	-	Rejected
H5: Perceived behavioural control influences consumers’ intention to buy OFGs.	PCTR/BINT	-	-	Rejected

Source: Data collected for the study.

T-values $>|1.96|$ are significant ($p < 0.05$)

Discriminating validity analysis was used mostly to confirm the validity of constructs involving the comparison of correlations between the constructs of the model and a theoretical model. Table 8 shows the results.

Table 8: Discriminating validity of the constructs.

Relation	Difference in χ^2	Difference in GL	P-value
HRBM/ATOF	46.373	1	0.000
ATOF/ATPU	42.72	1	0.000
ATPU/BINT	30.123	1	0.000

Source: Data collected for the study

Differences between χ^2 values of more than 3.84 were statistically significant (Lattin; Carrol; Green, 2011). Therefore, discriminating validity was confirmed for the final model.

5. Discussion

Our results reveal particularities of the local market, a metropolis in an underdeveloped region of an emerging country. Some of the original variables included in the questionnaire had to be removed in order to fit the proposed framework to the indicators required for the validation of a fitting model.

The original conceptual framework suggested a causal chain to the purchase behaviour related to: a) aspects of individual concerns, materialized in the construct HRBM (health-related beliefs and motivations) and b) environmental awareness *a priori* directly linked to organic foods, materialized in the construct ATEN (attitude in relation to the environment).

The first study hypothesis (H1a), which expressed a relationship between OF consumption and environmental awareness, was rejected. Nevertheless, most studies pointed the environmental concern as a second motivation to OF purchase. The results in the present study are aligned with other works that deny this connection, such as the initial studies of Davies et al. (1995), which found discrepant UK profiles related to people's concern regarding health and environment, confirming results of Lockie et al. (2002), who did not find environmental awareness as an independent purchase motivation. Similar results were attained by Yadav & Pathak (2016). These authors recently found that "environmental concern did not show any significant influence on purchase intention of organic food" in their developing country, India. It is relevant to consider that the low environmental awareness perception could likely be a delayed environmental concern in the developing countries, which might suggest that such result is aligned with those found more than a decade ago in the developed countries.

On the other hand, the OF motivation based on health-related factors (H1b) has been confirmed by this study, a finding supported by most of the studies reviewed (and specifically Cerjak et al. 2010 in Croatia and Slovenia and Chen, 2009), also in line with the following statement of Lockie et al. (2002:38): "A more reasonable conclusion is that among the plethora of competing demands and motivations faced by organic consumers, including a genuinely strong environmental commitment, the concern least likely to be compromised is that of personal and family health".

Following the chain analysis proposed by TPB, the construct ATOF (attitude in relation to OFGs) strongly influenced the construct ATPU (attitude in relation to OFG purchase), validating H2.

The hypothesis H3 assumed that ATPU (attitude in relation to purchasing of OFGs) exerted a positive influence on the intention to purchase the OFGs. The final model confirmed this influence, validating H3. The validation of H2 and H3 finalises the chain approach, linking beliefs and attitude to the purchasing action.

Finally, H4 and H5 were rejected as the fitting of the model, since SNRM (subjective norms) and PCTR (perceived behavioural control) had no measurable impact on the intention to purchase OFGs. These last two hypothesis rejections, despite possible practical consequences, are very interesting to the theoretical discussion on TPB, for the discussions on subjective norms and perceived behavioural control were the surplus of the TPB in relation to TRA. Therefore, these results align with other studies that do not use the TPB, but the original TRA (Tarkiainen & Sundqvist, 2005; Nasir und Karakaya, 2014; Nedra et al., 2015; Lee & Yun, 2015). They are also in accordance with the results from Yazdanpanah & Forouzani

(2015), who, after testing TPB, found that norms and behaviour control do not fit in the model either, the same as the studies of Yadav & Pathak (2016), in which norms also failed to explain the behaviour.

6. Conclusions

This study investigated the influence of aspects of environmental awareness and health seeking behaviours on consumers' intention to purchase organic fruits and greens (OFGs) in supermarkets and an agro-ecological fair in Fortaleza, North-east Brazil. For this purpose, it was proposed the use of the Theory of Planned Behaviour (TPB) as a conceptual framework, and structural equation modelling as the main statistical technique.

The socio-demographic data presented the female gender as predominant in the study sample. Most respondents had a college degree, and many had a post-graduate degree. Most of them reported a monthly family income over BRL 3,000 (approx. USD >1,200). Supermarkets were the most important OFG outlets.

In general, respondents perceived OFGs as healthier and better than their non-organic equivalents. The vast majority disagreed with the statement that OFGs are a hoax, or worse than non-organic foods, and agreed with the statement that they are more expensive than their non-organic equivalents. The findings described herein show that the constructs "Subjective norms" and "Perceived behavioural control" are not significant factors in the local context; thus, the existence of barriers to the purchase of OFGs does not necessarily imply that OFGs are not purchased and, vice-versa, ease of purchase does not mean OFGs are in fact purchased. Likewise, OFG consumption did not appear to depend on external social influences such as the opinion of close kin or significant others.

Hypotheses regarding the relations between OFG consumption and the constructs "environmental awareness" and "health" were formulated in light of TPB. The study analysis of the final model (which contemplated all such relations and associations) revealed that consumers' attitudes towards OFGs were impacted by health, well-being, beauty and quality of life-related aspects, but not by environmental awareness. These findings match the results of several other studies showing that consumers are primarily motivated by egoistic factors. Thus, the study question concerning environmental awareness and health seeking behaviours (including well-being, beauty, and quality of life) and their direct influence on consumers' intention to purchase OFGs may find a negative answer regarding environmental awareness, whereas affirmative in relation to health seeking.

The study presented some limitations. For instance, the questionnaire used to collect information was compiled from different works/sources. Most of the studies reviewed in this investigation used questionnaires adjusted to cultural contexts. Consequently, although prudently pre-testing the questionnaire, differences in context may have rendered some of the items in the study questionnaire less relevant or appropriate. In addition, due to limitations of time and resources, the respondent sample was restricted to the minimum size required for meaningful statistical analysis and consistent results.

The present investigation has potential academic and managerial implications. Regarding the former, i) it was conducted an empirical test of a well-established theoretical framework widely used to study consumers' behaviour, ii) it was employed structural equation modelling for the analysis, an

increasingly popular technique, which has been the object of much discussion worldwide due to its complexity, and iii) it was investigated the profile of a relatively unexplored consumer population. As to the managerial aspect, there is a contribution to the current knowledge of the factors determining the behaviour of a consumer population, which is expected to expand considerably in the near future. It is hoped that these findings will assist production and supply chain managers in the development and implementation of OFG marketing strategies.

7. References

- Aertsens, J., Mondelaers, K., Verbeke, W., Buysse, J. & van Huylenbroeck, G. (2011). The influence of subjective and objective knowledge on attitude, motivations and consumption of organic food. *British Food Journal* 113 (11), S. 1353–1378. DOI: 10.1108/00070701111179988.
- Aertsens, J., Verbeke, W., Mondelaers, K. & van Huylenbroeck, G (2009). Personal determinants of organic food consumption. A review. *British Food Journal* 111 (10), S. 1140–1167. DOI: 10.1108/00070700910992961.
- Ajzen, I. (1991). The theory of planned behavior. In: *Organizational Behavior and Human Decision Processes* 50 (2), S. 179–211. DOI: 10.1016/0749-5978(91)90020-T.
- Ajzen, I. (2001). Nature and Operation of Attitudes. *Annu. Rev. Psychol.* 52 (1), S. 27–58. DOI: 10.1146/annurev.psych.52.1.27.
- Ajzen, I. & Fishbein, M. (2008). Scaling and Testing Multiplicative Combinations in the Expectancy-Value Model of Attitudes. *Journal of Applied Social Psychology* 38 (9), S. 2222–2247. DOI: 10.1111/j.1559-1816.2008.00389.x.
- Ali, A., Khan, A. A. & Ahmed, I. (2011) Determinants of Pakistani Consumers Green Purchase Behavior: Some Insights from a Developing Country. *International Journal of Business and Social Science*, v. 2, n. 3, 217-226.
- Baker, S., Thompson, K. E., Engelken, J. & Huntley, K. (2004): Mapping the values driving organic food choice.: *European Journal of Marketing* 38 (8), S. 995–1012. DOI: 10.1108/03090560410539131.
- Beharrell, B. & MacFie, J. H. (1991): Consumer Attitudes to Organic Foods. *British Food Journal* 93 (2), S. 25–30. DOI: 10.1108/00070709110002706.
- Cerjak, M., Mesic, Z., Kopic, M., Kovacic, D. & Markowina, J. (2010) What Motivates Consumers to Buy Organic Food: Comparison of Croatia, Bosnia Herzegovina, and Slovenia. *Journal of Food Products Marketing*. 16 (3) 278-292 <http://dx.doi.org/10.1080/10454446.2010.484745>
- Chen, M.-F. (2007). Consumer attitudes and purchase intentions in relation to organic foods in Taiwan. Moderating effects of food-related personality traits. *Food Quality and Preference* 18 (7), S. 1008–1021. DOI: 10.1016/j.foodqual.2007.04.004.
- Chen, M.-F. (2009). Attitude toward organic foods among Taiwanese as related to health consciousness, environmental attitudes, and the mediating effects of a healthy lifestyle. *British Food Journal* 111 (2), S. 165–178. DOI: 10.1108/00070700910931986.

- Davies, A., Titterton, A. J. & Cochrane, C. (1995): Who buys organic food? A profile of the purchasers of organic food in Northern Ireland *British Food Journal* 97 (10), S. 17–23. DOI: 10.1108/00070709510104303.
- Dean, M., Raats, M. M. & Shepherd, R. (2008): Moral Concerns and Consumer Choice of Fresh and Processed Organic Foods 1. In: *Journal of Applied Social Psychology* 38 (8), S. 2088–2107. DOI: 10.1111/j.1559-1816.2008.00382.x.
- Essoussi, L. H. & Zahaf, M. (2009): Exploring the decision-making process of Canadian organic food consumers. *Qualitative Mrkt Res: An Int J* 12 (4), S. 443–459. DOI: 10.1108/13522750910993347.
- Fotopoulos, C. & Krystallis, A. (2002): Purchasing motives and profile of the Greek organic consumer. A countrywide survey. In: *British Food Journal* 104 (9), S. 730–765. DOI: 10.1108/00070700210443110.
- Gil, J. M., Gracia, A. & Sanchezgarcia, M. (2000): Market segmentation and willingness to pay for organic products in Spain. *The International Food and Agribusiness Management Review* 3 (2), S. 207–226. DOI: 10.1016/S1096-7508(01)00040-4.
- Global Organic Trade (2015): Worldwide: Market for organic fruits and vegetables expected to exceed \$62 billion by 2020. Global Organic Trade, <http://www.globalorganictrade.com/news.php?idx=276> accessed in 18.03.2016.
- Guillon, F. & Willequet, F. (2003) Les aliments santé: marché porteur ou bulle marketing? In: Déméter. *Economie et strategies agricoles. Agriculture et Alimentation*. Paris: Armand Colin.
- Guivant, J. S. (2003) Os supermercados na oferta de alimentos orgânicos: apelando ao estilo de vida ego-trip. *Ambiente & sociedade*. 6, 2, 63-82.
- Hair Jr., J. F., Anderson, R. E., Tatham, R. L. & Black, W. C. (2005) *Análise multivariada de dados*. (5. ed.) Porto Alegre: Bookman.
- Hoppe, A, Barcellos, M.D.; Vieira, L. M. & Matos, C. A. (2012): Comportamento do consumidor de produtos orgânicos. Uma aplicação da teoria do comportamento planejado. *BASE* 9 (2). DOI: 10.4013/base.2012.92.06.
- Hoppe, A., Vieira, L. M. & Barcellos, M. D. (2013): Consumer behaviour towards organic food in porto alegre. An application of the theory of planned behaviour. *Rev. Econ. Sociol. Rural* 51 (1), S. 69–90. DOI: 10.1590/S0103-20032013000100004.
- Hsu, S.Y., Chang, C.C. & Lin, T. T. (2016): An analysis of purchase intentions toward organic food on health consciousness and food safety with/under structural equation modeling. *British Food Journal* 118 (1), S. 200–216. DOI: 10.1108/BFJ-11-2014-0376.
- Hughner, R. S., McDonagh, P., Prothero, A., Shultz, C. J. & Stanton, J. (2007): Who are organic food consumers? A compilation and review of why people purchase organic food. *Journal of Consumer Behaviour* 6 (2-3), S. 94–110. DOI: 10.1002/cb.210.
- Lattin, J.M., Carrol, D. & Green, P. E. (2011) *Análise de dados multivariados*. São Paulo: Cengage Learning.
- Lee, H.J. & Yun, Z.S. (2015): Consumers' perceptions of organic food attributes and cognitive and affective attitudes as determinants of their purchase intentions toward organic food. *Food Quality and Preference* 39, S. 259–267. DOI: 10.1016/j.foodqual.2014.06.002.

- Lockie, S., Lyons, K., Lawrence, G. & Mummary, K. (2002): Eating 'Green'. Motivations behind organic food consumption in Australia. *Sociologia Ruralis* 42 (1), S. 23–40. DOI: 10.1111/1467-9523.00200.
- Magkos, F., Arvanti, F. & Zampelas A. (2006). Organic Food: buying more safety or just peace of mind? A critical review of the literature. *Critical Reviews in Food Science and Nutrition*, 46, 23–56.
- Magnusson, M. K., Arvola, A., Hursti, U.K., Åberg, L. & Sjöden, P.O. (2003). Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour. *Appetite* 40 (2), S. 109–117. DOI: 10.1016/S0195-6663(03)00002-3.
- Nasir, V. A. & Karakaya, F. (2014). Consumer segments in organic foods market. *Journal of Consumer Marketing* 31 (4), S. 263–277. DOI: 10.1108/JCM-01-2014-0845.
- Nedra, B.-A., Sharma, S. & Dakhli, A. (2015). Perception and motivation to purchase organic products in Mediterranean countries. An empirical study in Tunisian context. *J of Res in Marketing & Entrepre* 17 (1), S. 67–90. DOI: 10.1108/JRME-07-2014-0015.
- Onyango, B.M., Hallman, W. K., & Bellows, A. C. (2007). Purchasing organic food in US food systems. *British Food Journal* 109 (5), S. 399–411. DOI: 10.1108/00070700710746803.
- Özcelik, A. Ö. & Uçar, (2008) A. Turkish academic staffs' perception of organic foods. *British Food Journal*. 110, 9, 948-960.
- Paul, J.; & Rana, J. (2012): Consumer behavior and purchase intention for organic food. *Journal of Consumer Marketing* 29 (6), S. 412–422. DOI: 10.1108/07363761211259223.
- Portilho, F., Castaneda, M. & Castro, I. R. R. (2011) A alimentação no contexto contemporâneo: consumo, ação política e sustentabilidade. *Ciência e Saúde Coletiva*, 16, 1, 99-106.
- Radman, M. (2005): Consumer consumption and perception of organic products in Croatia. *British Food Journal* 107 (4), S. 263–273. DOI: 10.1108/00070700510589530.
- Rodrigues, R. R., Carlos, C. DE C., Mendonça, P. S. M. & Correa, S. R. (2009) A. Atitudes e fatores que influenciam o consumo de produtos orgânicos no varejo. *REMark - Revista Brasileira de Marketing*, São Paulo, 8, 1 jan./jun, 164-186.
- Santos, D. O., Veiga, R. T. & Moura, L. R. C. (2010) Teoria do comportamento planejado decomposto: determinantes de utilização do Serviço Mobile Banking. *Organizações em contexto*, 6, 12, jul-dez.
- Schafer, M., Nolting, B. & Engel, A. (2009): Organic agriculture as a new player in sustainable regional development? Case studies of rural areas in Eastern Germany. *IJARGE* 8 (2/3/4), S. 158. DOI: 10.1504/IJARGE.2009.026224.
- Schifferstein, H.N.J. & Oude-Ophuis, P.A.M. (1998) Health-related determinants of organic food consumption in The Netherlands. *Food Quality and Preference* 9 (3), S. 119–133. DOI: 10.1016/S0950-3293(97)00044-X.
- Seethaletchumy, T., Aye, K., Saravanan, M. & Yuen, Y.Y. (2015) Organic Food Consumption among Generation Y in Malaysia: A Conceptual Framework. *Journal of Applied Sciences* 15 (3), S. 570–575,
- Shafie, F.A. & Rennie, D. (2012): Consumer Perceptions Towards Organic Food. *Procedia - Social and Behavioral Sciences* 49, S. 360–367. DOI: 10.1016/j.sbspro.2012.07.034.
- Shaharudin, M. R, Mansor J. W. & Elias, S. J. (2010) Purchase Intention of Organic Food; Perceived Value Overview. *Canadian Social Science*. 6, 1, 70-79.

- Silva, J. S. (2006) *Modelagem de Equações Estruturais: apresentação de uma metodologia*. 105 f. Master Thesis PPGEPP, UFRGS.
- Tarkiainen, A. & Sundqvist, S. (2005) Subjective norms, attitudes and intentions of Finnish consumers in buying organic food. *British Food Journal* 107 (11), S. 808–822. DOI: 10.1108/00070700510629760.
- Thøgersen, J. (2006) Predicting consumer choices of organic food: results from the CONDOR project. In: JOINT ORGANIC CONGRESS, 2006, Odense, Denmark. *Proceedings...* Odense: JOC, 2006. Available on <http://orgprints.org/8068/01/Predicting_consumer_choices-CONDOR.pdf>.
- Thøgersen, J., Barcellos, M. D.; Perin, M. G. & Zhou, Y. (2015): Consumer buying motives and attitudes towards organic food in two emerging markets. *International Marketing Review* 32 (3/4), S. 389–413. DOI: 10.1108/IMR-06-2013-0123.
- Tomello, N. & Krischke, P. (2009) O comportamento de compra dos consumidores de alimentos orgânicos: um estudo exploratório. *Cadernos de Pesquisa Interdisciplinar em Ciências Humanas*, 10, 96, 27-43.
- Tsakiridou, E., Boutsouki, C., Zotos, Y. & Mattas, K. (2008) Attitudes and behaviour towards organic products. An exploratory study. *Intl J of Retail & Distrib Mgt* 36 (2), S. 158–175. DOI: 10.1108/09590550810853093.
- Wandel, M. & Bugge, A. (1997). Environmental concern in consumer evaluation of food quality. *Food Quality and Preference*. 8, 1, 19-26.
- Werner, J.; Alvensleben, R.v. (1984): Consumer Attitudes Towards Organic Food in Germany (F.R.). *Acta Hort.* (155), S. 221–228. DOI: 10.17660/ActaHortic.1984.155.38.
- Willer, H. & Kilcher, L. (2012) (Orgs.). *The World of Organic Agriculture. Statistics and Emerging Trends*: IFOAM, Bonn, & FiBL, Frick.
- Winter, C. K. & Davis, Sarah F. (2006): Organic Foods. *J Food Science* 71 (9), S. R117-R124. DOI: 10.1111/j.1750-3841.2006.00196.x.
- Xie, B., Wang, L., Yang, H., Wang, Y. & Zhang, M. (2015). Consumer perceptions and attitudes of organic food products in Eastern China. *British Food Journal* 117 (3), S. 1105–1121. DOI: 10.1108/BFJ-09-2013-0255.
- Yadav, R. & Pathak, G. (2016). Intention to purchase organic food among young consumers. Evidences from a developing nation. *Appetite* 96, S. 122–128. DOI: 10.1016/j.appet.2015.09.017.
- Yazdanpanah, M. & Forouzani, M. (2015). Application of the Theory of Planned Behaviour to predict Iranian students' intention to purchase organic food. *Journal of Cleaner Production* 107, S. 342–352. DOI: 10.1016/j.jclepro.2015.02.071.
- Zanoli, R. & Naspetti, S. (2002): Consumer motivations in the purchase of organic food. *British Food Journal* 104 (8), S. 643–653. DOI: 10.1108/00070700210425930.

CNC Machine Building Through Open Sources Projects and Programs

André Amorim Gonçalves Xavier¹, Flavio Maldonado Bentes², Marcelo de Jesus Rodrigues da Nóbrega³, Fabiano Battemarco da Silva Martins⁴, Hildson Rodrigues de Queiroz⁵

¹Mechanical Engineer (Unisuam). E-mail: andreamoringx@yahoo.com.br

²Post-Doctor in Mechanical Engineering (UFRJ), Doctor in Mechanical Engineering (UFRJ), Master in Mechanical Engineering (UnB). Senior Researcher (FUNDACENTRO), Rio de Janeiro, Brazil. E-mail: flavio.bentes@fundacentro.gov.br

³Post-Doctor in Civil Engineering (UERJ), Doctor in Engineering (PUC-Rio), Master in Technology (CEFET/RJ). Professor at UNIGAMA, CEFET-RJ and Santa Úrsula University, Rio de Janeiro, Brazil. E-mail: engmarcelocefet@terra.com.br

⁴Master in Agricultural and Environmental (UFRRJ), Professor at UNIGAMA and Santa Úrsula University, Rio de Janeiro, Brazil. E-mail: fabianobattemarco@gmail.com

⁵Master in Mechanical Engineering (UFF), Specialist in Petroleum and Natural Gas Engineering (Universidade PETROBRAS), Professor at UNISUAM, Petroleum Engineer (PETROBRAS), Rio de Janeiro, Brazil. E-mail: hildsonqueiroz@yahoo.com.br

Abstract

This research presents a theoretical and practical approach on the construction of a low-cost CNC machine, using as a base model found on the internet. Having his knowledge of movement that in the past was movement only one axis at a time, and in current controls movement on three simultaneous axes. The use of an Arduino micro controller will be the key part of the machine's operation, since it behaves like a PLC, starting from basic to advanced programming. The use of the project will end in its academic use and the dissemination of the technology used.

Keywords: CNC. Low cost. Opensource. Three axes. Arduino.

1. Introduction

The main responsible for the development is the FAA (American Air Force) and the aerospace industries. The precursor to this area is John Parsons and his partner Frank Stulen, where they were FAA contractors in 1940 and experimented with the use of coordinated data for cutting an airfoil. In March 1949, Parsons hired the Massachusetts Institute of Technology (MIT) laboratory to carry out studies on the systems, the creation of a prototype. (GROOVER, 2011).

In 1950 certain technical details were defined, such as the use of magnetic tapes to store the data, the reason was that the use of the punched card was not achieving the desired performance and details of the control system for the machine tools. And a patent was applied for in May 1952, however by the study done no machine has the Parsons-Stulen configuration. The prototype went into operation in March 1952, and some companies in the aviation sector requested test parts to gain knowledge of the machine's operating

characteristics. Some advantages were demonstrated, which included good cutting precision and repeatability, reduced machining time, and the ability to machine complex geometries. (LAMB, 2015).

The machines had a different configuration than today, they had the need for human intervention so that they could function correctly, so the exchange of the punched card for magnetic tapes, and in the future for diskettes and centralized data. (AZEVEDO, 2008).

The companies reacted cautiously in relation to the innovation, because without knowing how they would proceed in their facilities, for fear of the technology having a negative return with the teams to maintain the equipment. Thus, the FAA sponsored two tasks: First, the study of information in the industry and then the economic viability of the project. Thus, spreading the technology within the industries and taking its team of professionals to the laboratories to have demonstrations of the use of the machine and the economic study showed where the application would be more viable.

According to Azevedo (2008), the need for more complex systems, the alternative was to standardize operations and create a standard programming language, the G code, In the 50s CNC's began to obey direct orders from computers, as early as the mid-1970s, CAD / CAM systems started in the industries, thus replacing manual drawings.

CNC (Computer Numerical Control) controls have the ability to control the X, Y, Z axes simultaneously, allowing production time to decrease considerably, machine repeatability to be greater and the use of more complex projects to be executed with greater accuracy, where technology was made cheaper by the use of a micro controller from the year 2000, making it possible to be used in microenterprise and hobby media, and in 2009 Simen Svale Skogsrud released the first version of the GRBL (Integration of inverse kinematics), which is a controller for Cartesian axes X, Y and Z, which can be installed on a simple Arduino.

2. Theoretical reference

According to Santos and Sales (2004), the machining process is characterized by the transformation of the raw material into a defined geometry through the removal of material by shear in the form of chips. Among the manufacturing processes, machining stands out for the variety of methods that can be used and for its significant presence in the production chain of manufactured goods. Different technologies can be used to remove material in the machining process. In conventional machining, material removal occurs by the action of a cutting tool with defined geometry. This category includes several well-known manufacturing processes such as drilling, turning, milling, sawing, among others (SOUZA and ULBRICH, 2013; SANTOS and SALES, 2004).

In the milling process, the cutting tool rotates around its axis and meets the part, which performs the forward movements. A great feature is the versatility in the production of different geometries, besides guaranteeing high rates of material removal. In this process, the tool rotates while the piece, attached to the table, is responsible for the longitudinal and transverse feed movements. In some situations, the part may remain static while the cutting tool performs all the movements. (MACHADO et al., 2015).

According to Stoeterau (2004), milling operations can be classified into three basic types according to the movement of the tool: top or front milling, milling in three dimensions.

End milling, it is used one by a multi-edged cutter, which are wrapped around its axis, in addition to being a precise and very dynamic equipment for moving in several directions at the same time, speeding up the production and the cutting process and also being able to be applied in numerous variations within the industry.

It is the result of combined actions of the cutting tool's edges that are at right angles to the face of the part to be machined. The face after machining it is flat without having any relation with the teeth of the tool, among the processes mentioned above it has greater productivity, if it should be chosen as far as possible.

Being able to be used in horizontal and vertical cuts, we can emphasize that there are several models of cutter currently it is up to the identification of the work to be performed for the choice of the ideal tool, knowing that it has a diversity in formats that can be them: spherical, straight, with radius, chamfer. And their rods being: Parallel, conical, or welded in high-speed steel with special recess.

Milling in three dimensions the active teeth are located on the periphery (cylindrical surface) of the tool, and the tool axis is parallel to the surface to be machined. The tools used in tangential milling are called cylindrical or tangential milling cutters. The main disadvantage of this process is that the tool tends to have greater vibration, so fixing it with greater precision is necessary, the part to be machined is necessarily fixed because the cutting movement is inconsistent¹, soon there will be greater wear of the part and its useful life is reduced.

The chip thickness starts at zero and increases until the end of the cut. The cutting edge must be forced into the cut, creating a rubbing, or burning effect due to friction.

To quantify the cutting speed and feed speed, feed rate and cutting time, some equations will be established to relate cutter dimensions and rotation which are some of the initial equations to start. For milling and turning, the cutting speed is in equation 1:

$$V_c = \frac{(\pi \times d \times n)}{1000} \left(\frac{\text{mm}}{\text{min}} \right) \quad (1)$$

Where d is the tool diameter (mm); n is the number of revolutions per minute (rpm). The advance speed is given by equation 2.

$$V_f = f \times n \left(\frac{\text{mm}}{\text{min}} \right) \quad (2)$$

Where f is the advance is travel speed in each revolution (mm/revolution) and n is the number of revolutions per minute. The advance is given by equation 3.

$$F = \frac{l}{n} \text{ (mm/rev)} \quad (3)$$

Where l (mm/min) is the length machined; n is the main shaft rotation and f (mm/rev) is the feed per rotation. For the cutting time we will use the equation 4.

$$T_c = \frac{L_m}{I} \text{ (min)} \quad (4)$$

Where T_c (min) is the cutting time; L_m (mm) is the maximum part length and I (mm/min) is the length machined per minute. So, the machine example would have the sequence: The cutting speed for our 3mm diameter cutter with a machine rpm of 15000 will use 50% of its rpm. Applying the equation 1: $V_c =$

$$\frac{(\pi \times 3 \times 5000)}{1000} = 47.1698 \text{ m/min.}$$

Right in logical thinking our tool without any friction or friction we found this value for the best performance of our tool using a 3mm diameter cutter. With these data we can still calculate the tool cutting time using the formula, we will use a 100mm piece for calculation. Applying the equation 2: $T_c = 100/47.1698 = 2,12$ (min).

What is the feed rate per revolution when the main shaft rotation is 5000 rpm and the machined length per minute is 47.1698 mm/min.? Applying the equation 3: $f = 47.1698/5000 = 0.00943$ mm/rev

2.1. CNC Technology

The first job assigned was to John Parsons and his partner Frank Stulen, at Parsons Corporation, where he was an FAA contractor, and experimented with using the concept of data storage held on punched cards to define and machine parts. Thus, the beginning of CNC machines (computerized numerical control) appeared (GROOVER, 2013, p.112).

Presenting the evolution of technology and CNC followed this advance, creating increasingly automated systems, in 1958 a new language was created, the APT (automatically programmed tool) translated into Portuguese as an automatically programmable tool, created by Douglas Ross from MIT (Massachusetts Institute of Technology), thereby further reducing human interference in the machining process.

CNC tools are machines that do not need constant supervision by an operator, thus improving their manufacture. Numerical control is a system that allows the control of machines, being used mainly in lathes and machining centers. Allowing simultaneous control of several axes, through a list of movements written in a specific code (Lamb, 2015, p.30) the code sent to the machine follows a language pattern called G-code. It is the name given to the programming language created from the need for industrial machinery that used Command systems (CNC), later it will be explained.

The piece is designed in a cad (Computer Aided Design) software, and immediately afterwards it is directed to the CAM (Computed Aided Manufacturing) program, where in this program the G-code file is created, within it the standards that will be made will be established, the tool used, the cutting speed and the depth. Since the information is sent to the machine tool, where the instructions are read line by line and executing the selected drawing. The drawing can also be replicated in the CAM software, to increase its productivity and make parts in scales in a single schedule.

In order to obtain a competitive advantage and successfully survive in the current globalized business environment, the industry has incorporated automation techniques to meet the need for rapid adaptation to changes in the production system, ensuring acceptable production volume and product variability (MAGGIO, 2005).

For this, to improve the machines to develop products with greater precision and make a part different from what already exists on the market, a need is made. The integration of evolution with technology becomes essential for these demands and requirements to be met.

The axis of a CNC refers to the displacement in a direction to its Cartesian plane, since the number of axes that a CNC has is linked to the number of simultaneous machine directions. Bearing in mind that

the primary axes of (X, Y, Z) in their linear Cartesian coordinates, aim at the displacement of the machine, however the rotation axes are created 3 new axes called angular, thus the rotation on the X axis becomes axis A, the Y axis becomes the B axis and the Z axis becomes the C axis.

3. Mechanical, electronic elements and cost

3.1. Linear guide

The milling machines have guides to enable proper alignment with the spindles and provide smooth movement on the CNC machine axes. According to Costa (2006) “machine manufacturers started to use linear guides instead of traditional busbars, as they have high precision, excellent rigidity and smoother displacements”. Spindles and guides must work smoothly to reduce friction and the equipment to have the minimum of error. It is necessary to analyze the type of movement used (vertical, horizontal, or inclined) considering the forces and loads to increase the machine's useful life. Also according to Costa (2001), the spindles receive axial loads, and the linear guides allow the action of forces and moments in different directions, however all loads must be considered in the selection of components, however, for the execution of the project, such loads can be disregarded since that are too low.

3.2. Spindle

It is a straight bar formed by threads and continuous steps with an angle of 30°. This device is used in the execution of almost all industrial processes and applications that require a linear movement, this spindle has relatively great friction, however, it exerts a high tensile or compression force, and is still capable of transmitting high torque, which is the force which tends to turn or rotate objects.

It is widely used in industries and in machines, friction presses, load elevators, residential elevators, lathes and in milling machines and CNC machines. on stops and standardized elements and many accessories. About our project, the Tr8 spindle with a 2 mm pitch was selected so that there was greater precision during the machining process below the spindle precision account in relation to the steps.

3.3. Coupler

According to Kassouf (2004), “it would be ineffective to consider in a project a stepper motor or a high precision servo motor, if the components connected to them, such as: Couplings, reducers, positioners, ball screws, linear guides that they were unable to maintain in the system the level of precision and “repeatability” so desired ”

This need for power transmission of the pass motor has led industries to develop couplers that have the minimum clearance possible, since it connects the stepper motor with the spindle, in this case to the axis of the machine under study. Its main functions are the adjustment of the minimum misalignment, reduction of vibrations and loads to connected equipment due to not forcing the motor bearings, thus optimizing its useful life.

3.4. Stepper motors

Stepper motors are widely used in machine designs that need better control and precision, since the

stepper motor works in open and brushless loop that divides a complete rotation into several stages, this topic, since the stepper motor step works in open loop, this topic will detail its operation and the types of stepper motors on the market.

Step motors are electromechanical elements that convert electrical pulses into mechanical movements, obtaining minimum angular variation values.

According to Betiol (1989), "its power is digital electrical, or it drives, and its rotational movement is incremental". The speed of a stepper motor is given directly by the frequency of pulses and the rotated angle is related to the number of pulses applied. Unlike the brushless DC motor that rotates when direct current is applied, the stepper motor rotates at angles, thus increasing its machining accuracy, thus using the principle of electromagnetism. With the purpose and synchronous characteristics, the stepper motor is widely used in the construction of CNC machines, 3D printing, among other purposes. Due to these characteristics, it ensures practically constant positioning and speed control, plus precision, durability and simplicity are indispensable elements.

The stepper motor uses the same principle as all electric motors, Magnetism. Starting from this concept knowing that it does not rotate continuously, but in stages per rotation, thus creating angles per stage, where the permanent magnets represent the stator and the rotor is a coil of copper wires circulating the electric current. This current generates a magnetic field and the coil behaves with a magnet. The current being controlled, the forces of attraction and repulsion make the rotor rotate.

In the case of the stepper motor, this function of the electromagnets turning on and off in a sequence so that the rotor moves from one electromagnet to the other, where the motors have an iron shaft and surrounded by them has the coils. When voltage is applied to the coils, the rotor tends to align with the stator in the case of permanent magnet, and tends to find a minimum working space for the variable reluctance, so the coils are energized in a sequence in order to move the stator and axis for the operation of the stepper motor.

3.4.1. Types of stepper motors

According to Souza (2013), "depending on the construction characteristics, stepper motors can be classified into three types: permanent magnet, variable or hybrid reluctance".

- Permanent magnet stepper motor

Used mainly in computing, it has a smooth axis, generating simple and inexpensive mechanics, its advantage is that its magnetic field can be added to the magnetic field of the coils, giving a greater power, or Torque, but seeing that its magnets are not notches, have less precision in their execution, so the poles are alternative to the rotor axis. Upon receiving voltage the coils create magnetic fields, thus aligning the rotor to the stator field, so a sequence is created with the next stator so that the axis aligns with the coil, having this logic visible that energizing the coils in sequence the motor stride rotates at fixed angles. Within this engine we have the possibility of resolving it so that we can have greater precision during the machining process, however the increase in the number of phases and, consequently, the increase in the number of poles, can decrease the life of the engine, as it would result in temperature rise, even if the voltage is the same as the temperature between the coils can damage the circuits.

- Variable reluctance stepper motor

Also called switching variable reluctance, they consist of 3 to 5 coils connected to a terminal in common between them. common among them, it presents an advantageous resolution in relation to the permanent magnet, however little used due to its low torque. Its shaft is made of toothed non-magnetic soft iron and has no magnet, because when its magnetic field is energized, the rotor moves to reduce spaces between the stator and the teeth. The spindle teeth were designed so that, when aligned with a coil, they are misaligned with the next one, and so on, so that the coils are loaded in a fixed sequence, thus having the rotation of the motor. As with the permanent magnet, its resolution can be increased by increasing the coils per phase.

- Hybrid engine cost

This engine mixes the two technologies, thus giving greater torque and greater precision in the steps, ranging from 3.6° and 0.9°. Its axis consists of two groups of teeth, emphasizing the opposite poles, and having a toothed rotor that better guides the magnetic flow. The magnetic rotor has two bodies, each for a pole, so that the poles can be organized in a way that alternates to rotate the motor, so it has the same principle as the others of energizing the coils in sequence.

- Types of wiring

The motors are mainly biphasic, having their variation in being unipolar or bipolar, being that in the unipolar they have two windings per phase, being able to have a cable in common between each phase. The unipolar motor simplifies the operation because to operate them, there is no need to reverse the current in the drive circuit. In the bipolar motor, there is only one winding per pole, the direction of the current is changed in the circuit.

3.5. Cost

Table 1 below is the amounts spent for the execution of the project with materials that the author had, materials reused and supplied by friends, for the machine execution.

Table 1 – Costs

Items	Quantity	Cost (R\$)
Stepper motor	4	0
CNC shield	1	25,15
Stepper motor drivers	4	44,46
Arduino	1	56,43
Power supply	1	16,9
DC connector	1	5
Jumpers	20	22,99
Mini grinding machine	1	0
Left Y-axis motor support	1	70
Left X-axis car	1	0
Grinding Cart	1	0

Left bearing support Y axis	1	0
Right Y-axis motor support	1	0
X-axis right carriage	1	0
Y-axis right bearing support	1	0
Z axis car	1	0
Coupler	4	47,43
wood	1	0
Trapezoidal spindle 500mm	2	117,30
Trapezoidal spindle 300mm	1	74,57
Trapezoidal spindle 150mm	1	65,48
12mm linear bearing	4	53,40
688ZZ Bearing 8mm	4	32,40
500mm linear guide	2	20
300mm linear guide	2	20
150mm linear guide	2	20
Metal chestnut	4	35,24
Total	68	726,85

4. Conclusions

4.1. Mechanical part assembly

As the whole process was done by 3D printing, the parts alone were finished and ready for assembly, initially it was made on an MDF board to reduce costs, since the aluminum profile would contribute to a final cost higher. Using a square and ruler, the middle of the MDF (Medium Density Fiberboard) was marked to then drill and fix the parts of the machine tool base.

In this process, on each Y axis, 1 500mm guide rod, 1 2mm trapezoidal spindle, 1 nuts to reduce spindle clearance and maintain accuracy, 1 8mm / 5mm coupler, join the spindle to the stepper motor , 1 stepper motor, in addition to 2 M3 x 25mm screws, 1 608zz bearings, for the correction and alignment of spindle rotation in its final part.

• X-axis assembly.

For the construction of the shaft, 2 300mm guide rods, 1 300mm trapezoidal spindle, 1 8mm / 5mm coupler, attach the spindle to the stepper motor, 1 stepper motor 2 M3 x 25mm screws for fixing the stepper motor the X-axis part, 1 brown for the spindle, since the X-axis parts received two LM12UU bearings for the linear guide for better displacement and alignment during the manufacturing process, 1 608zz bearings, for the correction and alignment of rotation of the spindle in its final part

• Z-axis assembly

The following components were used in this axis, 2 guide rods with 14mm, 1 trapezoidal spindle with, 18mm / 5mm coupler, joining the spindle to the stepper motor, 1 stepper motor 2 M3 x 25mm screws to fix the stepper motor to z-axis carriage part, 1 brown for the spindle, 2 LM12UU bearings, 1 608ZZ

bearing for correction and alignment.

4.2. Electronic part assembly

The Shield V3 board is connected directly to the Arduino, there the pinouts will direct and where to place each pin of it, in addition to the drivers being embedded in the board, and with their calculated V_{ref} and put in their tripods.

To calculate the reference voltage, it is necessary that the formula used is according to the step used within the project, in our case we will use 1/16 microsteps.

$$V_{ref} = 8 \cdot I_{max} \cdot R_{cs} \quad (5)$$

V_{ref} is the reference voltage, coils constant = 8; I_{max} is the maximum amperage of stepper motors, and R_{cs} is the Resistor present in driver 4988.

Knowing that the stepper motors used are of dimensions that follow the Nema 17 standardization (SCHNEIDER, 2020), they have 3.8 kgf.cm of torque, step of 1.8° and maximum current of 1.2 A per phase, looking in the driver used we see that our resistor has 100mΩ or 0.1Ω then our used v_{ref} will be a value of 0.96V or 960 mV, following the equation.

In terms of power supply, the shield has its work within 12V to 36V, so it was chosen to work with an ATX source, and from the specifications, it was defined that the power supply must provide 12 V and 11.7 A . The power supply chosen was the standard ATX used in computers, with 264 W of power and voltage outputs of + 3.3V, + 5V, + 12V and -12V. The + 12V output provides currents of up to 14 A.

The tool is the part of the CNC machine that cuts the raw material. In a CNC router it is basically a high-speed motor that has on its axis a fixing rod (clamp) of the cutting tool called a milling cutter.

The spindle used in this work was the Black & Decker micro grinder with variable speed from 5,000 to 27,000 rpm and 180 W of power, 127 V. This is an inexpensive option that brings satisfactory results for work with light woods and polymers. If the user has a longer duty cycle, a more powerful motor or even another type of tool can be installed, such as a router.

The cutter is the part that is in contact with the raw material. Made to machine the material, they are built with a series of teeth and edges that cut the raw material in the direction of movement of the CNC machine, giving the desired shape. There are several types of cutters, for the most diverse uses and types of material, from roughing, drilling, finishing, engraving, among others.

After its assembly, it is necessary to install the GRBL firmware in the arduino IDE, so the procedure follows the reasoning. Initially, it is necessary to go to the Github website and download the GRBL 0.9J firmware, or whichever is more updated at the moment, after the download a zip file will be created on the computer's desktop, which must be unzipped.

Second step is to insert the GRBL file into the arduino library, to do that go in sketch and select the GRBL folder, now you can upload the firmware into your microcontroller, go to files> examples> grbl> grbl upload, then just click on transfer and wait for the completed information.

Universal CNC code sender was chosen for CNC control, as it is an easy-to-learn controller, and has a high command line, so it is necessary to install it on the computer, access the github website and download the zip file, and unzip the file on the desktop, the controller uses a java program for its execution, however it is only necessary to view the .windows file and double-click to start the program.

Having your follow-up, it is necessary to configure the GRBL control lines, in order to provide the machine with the working area limits, initial position and other commands, to view the settings, type in the \$\$ command line, from the \$ 0 lines up to line \$ 27 there is no need to make changes to the project, since no limit switches have been installed for the configuration.

The lines \$ 100, 101, 102, are the resolution part of the machine so to make this calculation it is necessary to have the knowledge of the motor steps, the spindle step and the selected microstep configuration, as we are not using the Gt2 belt the formula this will be used.

$$Resolution = \frac{microstep \times stepmotor}{spindle pitch} \quad (6)$$

The obtained resolution for this case is 1600, so this value obtained will be placed in each line to configure the resolution of your machine, the verification of the high value means that we will obtain greater precision during its machining, so we can also resort to the use of measurement materials to make the necessary corrections to the values obtained .

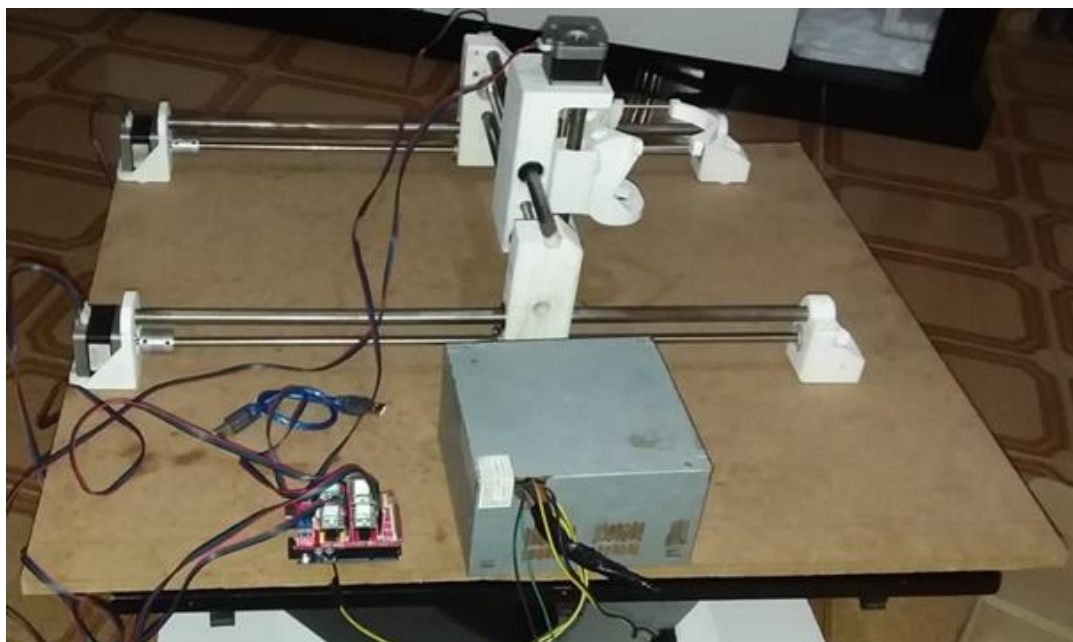
The lines \$ 110 to \$ 122 are referenced to the speeds of the stepper motor, so the speed of it will be selected by trial and error, in order to improve the resourcefulness of the machine and work with the highest possible speed without generating breakage of the milling material or that machining loses its quality.

The lines \$ 130 to \$ 132 refer to the dimensions of the machine proposed at work, so it is necessary to place the spindle measurements required by the author for the work to be carried out. All settings will be saved in the EEPROM (Electrically Erasable Programmable Read-Only Memory), so even if you turn off the Arduino, the settings will be kept so that it does not require configuration rework.

4.3. Final assembly

The assembly was completed with a total of three weeks, the steps were produced through the main structure in the case of MDF, alignment of the Y axes and fixation on the wood, X axis and Z axis, and after assembly of the stepper motors, installation of the electric components, so the machine is ready as figure 1.

Figure 1 - Final assembly



REFERENCES

- [1] AZEVEDO, Américo Luiz de. The beginnings of Computer Numerical Control. 2008 Available at: <<https://www.cimm.com.br/portal/publicacao/220-os-primordios-do-controle-numerico>>, Accessed on: 09 de jun. 2020
- [2] BETIOL, W. E. G., Stepper motor control applied to dot matrix printers. Curitiba, 1989.145 p.
- [3] COSTA, E. S. “Discipline: Machining Process”. Divinópolis, MG. 2006. 6 p. Available at:<<https://www.passeidireto.com/multiplologinreturnUrl=%2Farquivo%2F2612591%2Fapostilas-processes-de-machining-cefet-mg>>, Accessed on: 10 jun. 2020.
- [4] GROOVER, Mikell. Industrial Automation and Manufacturing Systems. 3rd Edition. São Paulo: CW, 2010.
- [5] KASSOUF, S. Elastic coupling without gap. Current mechatronics, São Paulo, December 2004. Number 19, 52 p.
- [6] LAMB, Frank. Industrial Automation in Practice. 2015 Available at: <https://books.google.com.br/books/about/Automa%C3%A7%C3%A3o_Industrial_na_Pr%C3%A1tica_S%C3%A9ri.html?id=X5XzCQAAQBAJ&redir_esc=y>, Acesso em 09 de jun.2020.
- [7] MACHADO, A. R. et al. Theory of material machining. 3rd ed. São Paulo: Blucher, 2015.
- [8] MAGGIO, Eduardo Gomes Ribeiro et al. A heuristic for scheduling the production of flexible manufacturing systems using modeling in Petri nets. 2005.
- [9] SANTOS, S. C.; SALES, W. F. Fundamentals of material machining. Belo Horizonte: CEFET-MG and PUC MINAS, Apostila, 2004.
- [10] SCHNEIDER. NEMA size 17 1.8 ° 2-phase stepper motor. [S.l: s.n., 2020]. Available in:<<http://motion.schneider-electric.com/downloads/quickreference/NEMA17.pdf>> Accessed on 31 jul. 2020.
- [11] STOETERAU, Rodrigo Lima. Design of Modern Machine Tools. Available at <<http://sites.poli.usp.br/d/pmr2202/arquivos/aulas/PMR2202-AULA%20RS1.pdf>> 2014. Federal University of Santa Catarina. Florianópolis, 2014. Accessed on 25 Mar. 2020.
- [12] SOUZA, Fabio. What is Arduino? 2013. Available at: <<https://www.embarcados.com.br/arduino-uno/>> Accessed on: 14 feb. 2020.
- [13] SOUZA, Adriano Fagali de; ULBRICH, Cristiane Brasil Lima. Integrated computer engineering and CAD / CAM / CNC systems. 2. ed. São Paulo: Artliber, 2013. Available at: <https://artliber.com.br/index.php?route=product/product&product_id=74> Accessed on 09 June. 2020.

Identification of Variables and Information Requirements for Implementation of Traceability in Egg Production

Denise Belloni Ferrari Furlan¹; Mario Mollo Neto¹; Ricardo César Gonçalves Sant'ana¹; Leda Gobbo de Freitas Bueno²; Marcelo Marques de Magalhães¹, Danilo Florentino Pereira¹

¹ São Paulo State University (UNESP), Faculty of Science and Engineering, Tupã/SP Brazil
Domingos da Costa Lopes Street, 780 - Jd. Itaipu - Tupã / SP - ZIP Code 17602-496
Phone: (55 14) 3404-4200

² São Paulo State University (UNESP), Faculty of Agricultural and Technological Sciences, Dracena/SP
Brazil - Rod. Cmte João Ribeiro de Barros, km 651 - Bairro das Antas - Dracena/SP
ZIP code 17900-000 Phone: (55 18) 3821-8200

Corresponding author: Mario Mollo Neto¹, mario.mollo@unesp.br

Abstract

Brazil is the 3rd largest egg producer in the Americas and for production to be achieved, it must be organized to produce with quality and productivity. For all quality requirements to be met, guidance documents such as EMBRAPA and the Brazilian Poultry Union cover all stages of the production process, from the origin of the inputs to the later stages of production. In addition to these instructions, other legislation dealing with traceability is used to regulate production processes in food chains. In this context, the objective of this work is to confront the main national and international standards related to traceability to verify common requirements and that can compose a system of data collection. The work was divided into three stages and presented as a result the common requirements: sanitary management in the breeding and rearing phases, lineage, input control, poultry vaccination, poultry feeding, sanitary monitoring, egg collection information, eggs, and biosafety, product description, batch identification, date of shipment and data of the sending company and data of the company of destination, in addition to the information retrieval system.

Keywords: Poultry keeping. Legislation. Food safety. Quality requirements.

1. INTRODUCTION

Brazil is the 3rd largest egg producer in America [1]. Its production chain is composed of input producers, poultry and egg producers, the processing industry, wholesale markets, retailers, and the egg industry and final consumer [2], [3].

Scandals due to outbreaks of bovine spongiform encephalopathy (BSE), birds contaminated with dioxin in Europe, E. coli O157: H7, the horsemeat scandal, coupled with the expansion of the supply chain

meant that there was a need to the improvement of food quality management processes [4], [5]. Traceability of information in food production has been implemented in industries to contribute to the availability and transparency of information [6].

The great difficulty in effectively implementing the traceability system is to integrate all links in the production chain through the registration link [4], [7], [5] and, in Brazil, there is no specific legislation that regulates the process for the egg production chain [8].

Based on the scenario presented, this work aims to analyze the main national standards that deal with food safety and traceability in laying poultry and compare them with international standards to verify the production and quality variables, and the production requirements. registration of information must be observed for the implementation of an information system for traceability.

2. LITERATURE REVIEW

Legislation on egg production

Brazilian egg-producing industries are governed by different regulations that address information that has been complemented over the years.

Historically, in Brazil, there was a sequence of laws that address the egg production system that evolved according to the food industry. In 1965, Decree 56,585 approved specifications for the classification and inspection of eggs. These specifications were used by the egg industry until the 1990s [9].

In 1990, the Ministry of Agriculture, Livestock and Supply (MAPA) created Ordinance No. 1, of February 21, 1990, which approved the general inspection rules for eggs and derivatives, which addresses from the definition of the common vocabulary to the egg production chain, going through the detailing of good practice actions, egg industrialization processes, such as pasteurization, freezing, cooling, hygiene aspects within the production processes, responsibilities for analysis and quality assurance [10].

Resolution No. 5 of July 5, 1991, brought the Identity and Quality Standard for Whole Egg to the production chain, among other products that emerged at the time, or that did not have an identity and quality standard for the industry to follow [11].

With application to all food industries, Ordinance No. 46, of February 10, 1998, brought the institution of the HACCP system to be gradually implemented in animal products industries.

According to the ordinance, HACCP is understood as an “analysis system that identifies specific hazards and preventive measures for their control, aiming at food safety, based on the prevention, elimination or reduction of hazards in all stages of the production chain.” [12].

In 2007, MAPA issued Normative Instruction 56, of December 4 of that year. The instruction establishes procedures for registration, inspection and control of breeding and commercial poultry establishments, detailing the stages of the egg production process, and other establishments related to the poultry industry [13].

To organize and transmit information on conservation and consumption to consumers, on June 17, 2009, Resolution No. 35 was introduced, which deals with specific labeling for eggs [14].

To complement the information provided by IN 56, 2007, in 2012, the necessary information was added for the good management of farms through Normative Instruction 36, of December 6, 2012 [15].

In addition to the standards presented, some are directly related to good practices in egg production in Brazil, detailing the stages of production of a farm, they are i) Technical Circular nº 49 - Good Production Practices in Commercial Posture [16]; ii) Good Egg Production Practices Protocol [17].

Technical Circular No. 49, prepared in 2006 by EMBRAPA is a normative document that was created based on specifications of legislation, health requirements, and food hygiene standards aiming at food safety [16].

To complement these requirements, the so-called “*União Brasileira de Avicultura*” (UBA) was created in 2008, the Protocol of Good Practices for egg production, to be used as a guiding document for producers in Brazil.

In addition to being based on the requirements of Technical Circular No. 49, it is also supported by the *Codex Alimentarius* recommendations and production manuals of Brazilian and foreign companies. Its character is guiding, to improve the quality of the national production system, excluding its character of mandatory adoption by companies [17].

Applied to establishments that carry out activities of production, industrialization, storage, fractionation, transport, distribution, import and commercialization of food, RDC nº 24, of June 8, 2015, brought the criteria and procedures for the collection of food, containing the actions necessary to inform ANVISA and consumers of food recalls available on the market. This legislation indicates that companies must maintain records that allow the identification of non-compliant products distributed in the markets [18].

Identification and traceability system

Concern about the traceability of food products has arisen in the past two decades after outbreaks of spongiform encephalopathy in bovines -BSE [19], [4] and birds contaminated with dioxin in Europe [4], E. coli O157: H7 [19].

Outbreaks related to the variant of Creutzfeldt-Jakob disease through contaminated meat products in the late 1980s and early 1990s. Likewise, an outbreak of salmonella and Escherichia coli in Germany in 2011. Other outbreaks that caused interruptions in the supply of products were mainly the horsemeat scandal in 2013 that caused the biggest recall of processed meat from European retail companies, such as Tesco, Ica, and Ikea Foods [20].

The basic components of a traceability system can vary according to the objectives of the system and are i) product, which brings as essential information the type and quantity, and ii) process, addressing the type of process and the duration time. From these elements, other information can be added to the traceability process, such as species, variety, quality attributes, weight, volume, harvest or slaughter period, among others [21].

To guarantee food safety, there was a need to improve the systems for monitoring production processes. In parallel, there was a process of expanding the food supply chain and the available traceability systems were unable to guarantee the consumer all the necessary information about the product he was purchasing [4], [5].

One of the major difficulties in the effective implementation of the traceability system is to integrate all links in the production chain through the registration link [4], [7], [5]. These updated and linked records

are essential to obtain the necessary data to feed the system.

In addition to the inability to link records between food chain links, [3] also reported that there are inaccuracy and errors in the records, which causes delays in obtaining data when they are demanded. They also report the importance of systematized information across the chain and point out as the main problem the lack of common standards for coding and managing information between the chains. The regulation also points out that there is a need for effective monitoring of the food and feed sector. These can be compromised if it is not possible to identify its origin in cases of eventualities that impact food safety.

Among the various definitions of the concept of traceability, there are two ISO Standards that provide complementary information and are suitable for the food industry. The first is ISO 9000, which provides a more succinct definition that identifies traceability as “the ability to trace the history, application or location of what was considered as an object of analysis”.

ISO 22005, on the other hand, provides the same definition, but it is a standard specifically applied for the traceability of the food industry. Alongside these two definitions, Codex Alimentarius says that traceability is about the “ability to follow the movement of food through specific stages of the production chain, in processing and distribution [22].

To complement these concepts, on September 19, 2011, EU Implementing Regulation No. 931/2011 regarding traceability requirements previously established appeared.

The regulation specifies the main points that should be noted when carrying out traceability in animal production food chains: a) exact description of the foodstuff; b) volume or quantity; c) name and address of the shipping company; d) name and address of the owner of the shipping company (if different from the previous item); e) name and address of the destination of the product; f) name and address of the owner of the destination company (if different from the previous item); g) batch or shipping reference; and, h) date of shipment.

In addition to the points needed to perform traceability, the TRU (Traceable Resource Unit) unit that deals with the definition of the size of the lots.

For production processes where the sizing of production occurs through the formation of batches, TRU is unique, addressing the characteristics unique to that processing. On the other hand, when the production process is continuous, the sizing of production and the change in TRU occurs when a raw material or processing conditions change [21].

Traceability plays a key role in ensuring food safety for consumers, as it guarantees the possibility of recalling, eliminates products not suitable for consumption, and mainly promotes the investigation of the causes of food safety issues [7]. According to the authors, the USDA (United States Department of Agriculture) ensures that a well-implemented traceability system can provide lower costs, reduced recall expenses, and higher sales of products with specific attributes, once the customer has access to all information regarding the product you are purchasing [7].

In this sense, in a study by [23] on consumers' perception of traceability, it was found that consumers are concerned with traceability, and relate its importance to the contribution to food collection, however, many believe that traceability can contribute to the increase in the price of food. even providing food security.

Ringsberg states that there is a lack of information between the academic area and the food sector to

contribute to the issue of traceability, causing important information to cease to be transmitted between sectors [20]. On the other hand, the author mentions that the exchange of information between food companies and government authorities is increasing due to the increase in the number of recalls caused by failures in Good Manufacturing Practices, in the process of labeling, packaging, and cross-contamination in the production lines, mainly for allergenic foods, such as eggs, peanuts, milk and gluten [20]. In addition to problems related to cross-contamination, recall processes can come from other causes, such as insufficient control of production conditions, the presence of microbial agents, chemical additives, or substances foreign to the process and product and also in the quality control of products. food, for example, temperature, humidity, or bacteria that can develop and compromise food safety and, subsequently, human health [20], [3].

Given the difficulties encountered by the food production chain in implementing an efficient traceability model and that there is communication between the links, there are technologies that are emerging to solve this problem. Some technologies used are the FTTO - Food Track and Trace Ontology (food tracking theory) [3], which guarantee interaction between heterogeneous databases and that merge at a given time to make the data available.

Other models used are the Critical Tracking Point - CTP combining with the Trace Food Framework model of food traceability [7], which offer advantages for improving the efficiency and compatibility of traceability systems. Both guarantee security, access to data, and ownership of information.

Furthermore, when analyzing traceability through the need that is inserted in all links in the supply chain, [20]; [24] demonstrated the importance of food labeling, especially single labeling, for single foods. Within this context, they mention the importance of an efficient packaging system in the food industry. The author also points out the use of RFID (Radio-Frequency Identification), which is the identification through radio frequency and barcode to improve the traceability of unitary products [20].

On RFID technology, [25] reported that they have many advantages such as the amount of data that can be inserted in a label, the reading speed, the possibility of simultaneous reading of several labels. On the other hand, the price of implementation is limiting.

Used in laying hens, the QR Code was developed in Japan in 1994 by Denso Corporation [26]. The Quick Response Code or Quick Response Code is a two-dimensional digital image that carries a set of data and can be easily accessed through the camera of a mobile device [27].

The possibilities of using the code are diverse and can be used in areas such as production, logistics, sales. A code is generated from algorithms, which are grouped sequentially until the QR Code is formed. [26]. Regarding the application and use of the QR Code in food, [25] identified products such as wheat flour and wine. Besides, there is an application of 2D barcode in layers, applying the code in the beak and feet. Technologies assist in the process of obtaining traceability data.

Each organization treats this system in different ways. In this sense, in 2015 the Chinese began, with the leadership of the FDA (Food and Drug Administration), a national program for the implementation of traceability systems in the food industries. For the process to start, there was a need to develop anti-fraud technologies for agricultural products, the initial stage of the supply chain. It was necessary to know all the links in the supply chain and, above all, to be able to monitor all the important points for traceability. To be able to register them efficiently, where information was not lost in the middle of the processes was also the

great challenge encountered by the Chinese [24], [6].

3. MATERIAL AND METHODS

This work is divided into three stages. The first consisted of assessing the main national laws that address the egg production system and identifying the quality requirements that can, or should be, tracked. This analysis was delimited in the documents of EMBRAPA, UBABEF, MAPA, and ANVISA. A chronological approach to the legislation was carried out, and Technical Circular No. 49, prepared in 2006 by EMBRAPA, is a normative document that was created based on legislative specifications, health requirements, and food hygiene standards aiming at food security for poultry farming of posture [16].

To complement these requirements, the so-called “União Brasileira de Avicultura” (UBA) was created in 2008, the Protocol of Good Egg Production Practices, used as a guiding document for producers in Brazil. In addition to being based on the requirements of Technical Circular No. 49, it is also supported by the *Codex Alimentarius* recommendations and production manuals of Brazilian and foreign companies. Its character is guiding, to improve the quality of the national production system, not have a mandatory character [17].

To inform companies about the main requirements for carrying out food recalls, it appeared in 2015, applied to establishments that carry out activities of production, industrialization, storage, fractionation, transportation, distribution, import and commercialization of food, RDC nº 24, of 08 of that year, brought the criteria and procedures for the collection of food, containing the necessary actions to communicate to ANVISA and consumers the recalls of food available on the market.

In the second stage, the information registration requirements available in EU Regulation No. 931/2011 and ISO 22005: 2008 on traceability were analyzed, to define the conditions for registration.

In the third stage, the requirements raised in the previous stages were confronted, seeking to highlight the needs or care in the procedure of collecting this information so that the quality and integrity of the information in a future traceability system is guaranteed.

4. RESULTS AND DISCUSSION

As shown in Table 1, Technical Circular No. 49 and BPPO are laws that address good practices for the production process within poultry farms and in the previous and subsequent stages. Normative Instruction 56 of 2007 establishes procedures for registration, inspection, and control of poultry establishments and Normative Instruction 36 of 2012 complements this information. Collegiate Board Resolution No. 24 deals with recall procedures in the food industry.

Table 1 - Quality requirements required by the main national legislation.

Quality requirements	Standards				
	Technical Circular n° 49, 2006 (EMBRAPA)	BPPO, 2008 (ABPA)	IN 56, 2007 (MAPA)	IN 36, 2012 (MAPA)	RDC 24, 2015 (ANVISA)
Purchase, transport and accommodation of chicks	x	x	x		
Health management in the breeding and recreating phase	x	x	x		
Lineage	x	x	x		
Debicage	x		x		
Control of inputs	x	x		x	
Division by lots		x	x		x
Destination of dead birds	x	x			
Manure management and poultry litter	x	x		x	
Poultry vaccination	x	x		x	
Bird housing	x	x		x	
Health monitoring	x	x			
Poultry feed	x	x		x	
Type / quantity of egg collection	x	x			
eggs classification	x	x			
Biosecurity	x			x	
Construction of the aviary	x			x	
Personal and environmental hygiene	x				
Mandatory registration with competent agencies	x	x	x	x	
Record of all events involved in the process		x	x		x
Product identification at all stages		x			x
Integrated pest management	x	x		x	
Official physical and chemical analyzes		x	x	x	
Batch shipping data (date, invoice, quantity, customer)			x		x

Embrapa's Technical Circular no. 49 and the BPPOs have a guiding character, therefore they are not mandatory, and the quality requirements understood by them assume that safe food is produced in plants where these requirements are met.

The increase in productive potential is directly related to the genetic selection of broiler and laying poultry strains. At the same time, there is an increase in the incidence of diseases and behavioral problems and animal welfare [28] making it necessary to register the requirements for lineage, vaccination of birds, and biosecurity.

Salmonella is often found in poultry products. [29] reported that there is a greater chance of contamination by Salmonella when the product is stored at 30°C and less possibility when refrigerated at

8°C. Contamination can occur via shell or during egg formation, from the bird's infected reproductive tract [1]. Based on this information, it is necessary to register the sanitary management requirements of the breeding and rearing phase, sanitary monitoring, egg collection, egg classification.

In the stages of breeding and recreating, collecting egg classifications, sanitary control has a preventive character, providing greater safety to products from establishments that do so, to the detriment of those that do not offer conditions to do so. Besides, in hot climates, with high temperatures for much of the year, animals suffer from climate change, especially in the breeding system in sheds, which require forced ventilation and evaporative cooling through the sprinkling of microdroplets of water to cool the environment and make it more pleasant for birds, as well as a sealing system that reduces air losses and heat exchanges with the external environment. In open warehouses, at a lower cost, the ventilation system is natural, with or without the aid of fans [30], [31].

It is important to record the requirements for poultry feed and input control because the feed is exclusive of plant origin, and the addition of synthetic pigments and growth promoters is prohibited [3]. The acquisition of good quality inputs that meet the needs of birds at different ages is directly related to growth and production efficiency.

The identified requirements are pointed out in two or more standards presented, demonstrating the importance of recording this information in a system of traceability in egg production, whereas they may not be mandatory variables, and may not be adhered to the system of the producer.

When comparing this data with the requirements contained in EU Regulation No. 931/2011 (Official Journal of the European Union) and ISO Standard 22005: 2008 [32], according to Table 2, it is possible to observe that they deal with different requirements, but complementary.

These standards deal with the traceability system and thus point out important informational requirements for the process.

Regarding the necessary characteristics for a traceability system to be executable, [24] identified three basic characteristics: i) batch identification, ii) information about the production process and iii) a system that interconnects this data. For a product to be traceable it must have at least one traceable unit of information, such as the batch. Thus, the important information requirements to be registered are batch identification, documentation of material and information flow, and information retrieval system.

Table 2 - European and certification requirements.

Information requirements	Standards	
	EU regulation 931/2011	ISO 22005:2008
Product description	x	x
Lot ID	x	x
Shipping date	x	x
Shipping company details	x	
Product target company data	x	
The flow of documented materials and information		x
Records management		x
Information retrieval system		x

The documentation of the flow of materials and information is directly related to the information surrounding a product at the time of shipment, such as the description of the product, the date of shipment, the data of the selling and shipping company, in addition to the lot. In this sense, the registration of this information is essential for the process of tracking the products claimed through the dissemination of information through the later stages of the production chain [4], [7], [5].

European regulation is more specific when it mentions exactly the requirement that must be registered, whereas ISO 22005: 2008 does not specify all its important requirements, so organizations can have different interpretations and their records do not converge when feeding a system. On the other hand, it indicates that the organization has a responsibility to know its suppliers and customers, maintain updated information, meet customer specifications, facilitate consultations in case of product recall and facilitate the verification of information within the organization [33].

5. CONCLUSION

To guarantee the quality of the egg produced and the compliance with the legislation addressed, the traceability system must record quality variables related to health management in the breeding and rearing stages, lineage, input control, vaccination of birds, feeding of birds, health monitoring, information on egg collection, egg classification and biosecurity, associated with the registration of information variables, such as batch identification, material flow documentation, and information, including product description, shipping date, company data sender and data of the destination company, and information retrieval system.

6. ACKNOWLEDGMENT

This work was supported by the Brazilian National Council for Scientific and Technological Development – CNPq and São Paulo Research Foundation – FAPESP.

7. REFERENCES

- [1] ALMEIDA, C.A; FRIEBEL, D; DA ROSA, R.B, GELINSKI, J.M.L.N. Avaliação das condições higiênico-sanitárias da casca e gema de ovos in natura. Anuário pesquisa e Extensão Unoesc. Videira, v.2, 2017.
- [2] DONATO, D.C.Z; GANDRA, E.R de S.; GARCIA, P.D.S.R; DOS REIS, C.B.M; GAMEIRO, A.H. A questão da qualidade no sistema agroindustrial do ovo. In: CONGRESSO SOBER, 47, 2009, Brasil. Anais... Porto Alegre, 2009. p. 1-13
- [3] PIZZUTI, T.; MIRABELLI, G.; SANZ-BOBI, M.A.; GOMÉZ-GONZALÉZ, F. Food Track & Trace ontology for helping the food traceability control. Journal of Food Engineering, v.120, p. 13-30, 2014.
- [4] ZHAO. J.; ZHU.C.; ZHENZHEN X. Z.; JIANG, X.; YANG, S.; CHEN, A. Microsatellite markers for animal identification and meat traceability of six beef cattle breeds in the Chinese market. Food Control,

v.78, p. 469-475, 2017.

[5] GOGLIANO SOBRINHO, O; CUGNASCA, C.E.; FIALHO, F.B.; GUERRA, C.C. Modelagem de um sistema de informação para rastreabilidade na indústria do vinho baseado em uma arquitetura orientada a serviços. *Engenharia Agrícola*. v. 30, n. 1, p. 100-109, 2010.

[6] TENG, W.; MAO, B.; CAO, J. A Multi-level Traceability System Based on GraphLab. *Procedia Computer Science*, v.91, p. 971-977, 2016.

[7] BADIA-MELIS, R.; MISHRA, P.; RUIZ-GARCÍA, L. Food traceability: New trends and recent advances. A review. *Food Control*, v.57, p.393-401, 2015.

[8] DENADAI, J.C.; DUCATTI, C.; SARTORI, J.R.; PEZZATO, A.C.; MÓRI, C.; GOTTMANN, R.; MITUO, M.A.O. Rastreabilidade da farinha de carne e ossos bovinos em ovos de poedeiras alimentadas com ingredientes alternativos. *Pesquisa Agropecuária Brasileira*. v. 44, n. 1, p. 1-7, 2009.

[9] CÂMARA DOS DEPUTADOS. Decreto nº 56.585, de 20 de julho de 1965. Disponível em: <http://www2.camara.leg.br/legin/fed/decret/1960-1969/decreto-56585-20-julho-1965-396950-publicacaooriginal-1-pe.html>

[10] MAPA (Ministério da Agricultura, Pecuária e Abastecimento). Portaria nº1 de fevereiro de 1990. Disponível em: <http://extranet.agricultura.gov.br/sislegis-consulta/consultarLegislacao.do?operacao=visualizar&id=5594>

[11] MAPA (Ministério da Agricultura Pecuária e Abastecimento) Resolução nº 5, de 5 de julho de 1991. Disponível em: https://www.google.com/search?ei=7kWEW5W6EYTAwASpnLuwBg&q=Resolu%C3%A7%C3%A3o+N%C2%BA+5%2C+de+5+de+julho+de+1991+&oq=Resolu%C3%A7%C3%A3o+N%C2%BA+5%2C+de+5+de+julho+de+1991+&gs_l=psy-ab.3...1736.1736.0.3155.1.1.0.0.0.228.228.2-1.1.0....0...1.1.64.psy-ab..0.0.0....0.q_rXmn8jgtw

[12] MAPA (Ministério da Agricultura pecuária e Abastecimento). Portaria nº 46, de 10 de fevereiro de 1998. Disponível em: <http://extranet.agricultura.gov.br/sislegis-consulta/consultarLegislacao.do?operacao=visualizar&id=1139>

[13] MAPA. Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa nº 56, de 04 de dezembro de 2007. Disponível em: <http://sistemasweb.agricultura.gov.br/sislegis/-action/detalhaAto.do?method=visualizarAtoPortalMapa&chave=1152449158> .

[14] ANVISA (Agência Nacional de Vigilância Sanitária). Resolução Diretoria Colegiada nº35, de 17 de

junho de 2009.

[15] MAPA. Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa nº 36, de 06 de dezembro de 2012. Disponível em: <https://www.avisite.com.br/legislacao/anexos/20121012_in20120612.pdf>.

[16] EMBRAPA. Circular técnica nº49: Boas práticas de produção na Postura Comercial. Concórdia/SC: dezembro de 2006, 40p. Disponível em: <<https://www.embrapa.br/suinos-eaves/busca-de-publicacoes/-/publicacao/443776/boas-praticas-de-producao-na-postura-comercial>>.

[17] ABPA – ASSOCIAÇÃO BRASILEIRA DE PROTEÍNA ANIMAL. Protocolo de Boas Práticas de Produção de Ovos. JUNHO 2008. DISPONÍVEL EM: <<http://www.ubabef.com.br/publicacoes?m=82>>.

[18] ANVISA – Agência Nacional de Vigilância Sanitária. Resolução de Diretoria Colegiada nº 24, de 08 de junho de 2015. Disponível em: <portal.anvisa.gov.br/.../10181/.../RDC_24.../d0d99450-1152-4f7a-91b9-1130fcb17fa...>.

[19] HOBBS, J.E. Information asymmetry, and the role of traceability system. *Agribusiness*. v.20, n.4, p. 397-415, 2004.

[20] RINGSBERG, H. Perspectives on food traceability: a systematic literature review. *Supply Chain Management: An International Journal*, v.19, p. 558-576, 2014.

[21] MOE, T. Perspectives on traceability in food manufacture. *Trends in Food Science & Technology*.

[22] OLSEN, P.; BORIT, M. How to define traceability. *Food Science and Technology*, v.29, p.142– 150, 2013.

[23] ANDRADE, J. C.; DELIZA, R.; YAMADA, E. A.; GALVÃO, M. T. E. L.; FREWER, L. J.; BERAQUET, N. J. Percepção do consumidor frente aos riscos associados aos alimentos, sua segurança e rastreabilidade. *Brazilian Journal of Food Technology*, v. 16, n. 3, p. 184-191, jul./set. 2013.

[24] AUNG, M.M.; CHANG, Y.S. Traceability in a food supply chain: Safety and quality perspectives. *Food Control*, v.39, p.72-184, 2014.

[25] TARJAN, L., ŠENK, I., TEGELTIJA, S., STANKOVSKI, S., OSTOJIC, G. A readability analysis for QR code application in a traceability system. *Computers and Electronics in Agriculture*, v.109, p. 1–11, 2014.

[26] LIU, Y.; YANG, J.; LIU, M. Recognition of QR Code with mobile phones. *School of information science and engineering*. China: University of Jinan, 2008.

- [27] CATA, T.; PATEL, P. S; SAKAGUCHI, T. QR CODE: A New Opportunity for Effective Mobile Marketing. *Journal of Mobile Technologies, Knowledge and Society*. v. 2013, p. 1-7, 2013.
- [28] MAZZUCO, H. Ações sustentáveis na produção de ovos. *Revista Brasileira de Zootecnia*. v.37, p. 230 – 238, 2008.
- [29] PINTO, A.T.; SILVA, E.N. Ensaio de penetração de *Salmonella Enteritidis* em ovos de galinha com diferentes qualidades de casca, submetidos ou não a lavagem industrial e duas temperaturas de armazenamento. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*, v.61, n. 5, p.1196 – 1202, 2009.
- [30] AMARAL, G. F.; GUIMARÃES, D. D.; NASCIMENTO, J. C. O. F.; CUSTODIO, S. Avicultura de postura: estrutura da cadeia produtiva, panorama do setor no Brasil e no mundo e o apoio do BNDES. *BNDES Setorial*, Rio de Janeiro, n. 43, p. 167-207, 2016.
- [31] FARIA, J. M. Dinâmica estrutural do setor produtivo de ovos: uma análise a partir das empresas líderes brasileiras. Rio Grande do Sul: UFRGS, 2013. 113 p. Dissertação (Mestrado) - Programa de Pós-Graduação em Agronegócios, Universidade Federal do Rio Grande do Sul, Porto Alegre, 2013.
- [32] MAGALHÃES, A. ISO 22005:2007 – Rastreabilidade na cadeia alimentar. *Segurança e qualidade alimentar*, n. 3, 2007.
- [33] ABNT - ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. NBR ISO 2005. Rastreabilidade na cadeia produtiva de alimentos e rações — Princípios gerais e requisitos básicos para planejamento e implementação do sistema. Rio de Janeiro, p. 14. 2008.

Professional Development in training and Tutoring

Have I really gained experience and skill through training and tutoring sessions? Case of: a special third year student, language sciences and didactics (SLD), Department of English, University of Bejaia

Dr. Salima MAOUCHE-KETFI

Department of English, University of Bejaia

salima_maouche@yahoo.fr

Abstract

Practitioner engagement is not an easy task in teaching in higher education. In fact, there is much evidence now to propose a strong relationship between active engagement and the quality of the teaching experience. But what exactly do we mean by 'engagement'? For many it simply refers to assisting students to connect with the subject material in a way that generates interest, enjoyment and interaction. Generating active participation is particularly important in tutorials or small group teaching, where tutorials 'by design', are intended to provide students a different kind of learning experience than the lecture. It is also through active engagement that both, teachers and students take greater ownership for their teaching craft and learning process. This concept assists in the development of an overall design or structure to support such engagement and active participation. The more organized and clear the teachers and students are, the more likely it is that they will get the desired and target results. In addition to this, active engagement of teachers should be reinforced by a reflective practice which is an active process too of attending to their own experience of teaching in order to explore it in some depth. It is in fact a 'dialogue of thinking and doing through which teachers become more skilled. This process develops by thinking critically and deeply about what teachers are doing in order that they may transform that experience and reapply it in new contexts. In many respects, Professional Development in training and tutoring has been designed to motivate reflection on one's teaching practice and mostly where teachers have an opportunity to see others in practice. The article's results have been derived from the interpretation of the data collected through designing an interview addressed to the only special student of the department and show the researcher's experience as a teacher and an administrator with Abdenour, this is how I like to call him, a blind student, but his determination and willingness to succeed in his higher studies made of him a remarkable young man. Special tutoring and training sessions have been designed to enable him fully integrate the learning community. Therefore, this article has been directed to focalize on the pedagogical decisions based on implementing and considering the training and tutoring sessions as a necessity to develop first the teaching craft and then help, advise and guide our students towards more success in their studies. Is not it mentioned in the official document (Journal officiel de la République Algérienne N°23 du 4 Mai, 2008 ; articles 33,34, 35, ...) « to receive the students 3 hours/week to advise and orient them »?

Key words: Professional Development, Training and Tutoring, Special student, Active engagement, Active participation, Motivate reflection, Critical thinking.

1. Introduction

Practitioner engagement is not an easy task in teaching in higher education. In fact, there is much evidence now to propose a strong relationship between active engagement and the quality of the teaching experience. But what exactly do we mean by ‘engagement’? For many it simply refers to assisting students to connect with the subject material in a way that generates interest, enjoyment and interaction. Generating active participation is particularly important in tutorials or small group teaching, where tutorials ‘by design’, are intended to provide students a different kind of learning experience than the lecture. It is also through active engagement that both, teachers and students take greater ownership for their teaching craft and learning process. This concept assists in the development of an overall design or structure to support such engagement and active participation. The more organized and clear the teachers and students are, the more likely it is that they will get the desired and target results. In addition to this, active engagement of teachers should be reinforced by a reflective practice which is an active process too of attending to their own experience of teaching in order to explore it in some depth. It is in fact a ‘dialogue of thinking and doing through which teachers become more skilled. This process develops by thinking critically and deeply about what teachers are doing in order that they may transform that experience and reapply it in new contexts. In many respects, Professional Development in training and tutoring has been designed to motivate reflection on one’s teaching practice and mostly where teachers have an opportunity to see others in practice. An opportunity to learn about a number of effective and innovative practices which can improve students’ engagement and participation as well as developing the teaching craft in higher education has been provided through the implementation of the new educational reform in these institutions; the implementation of the LMD system. It is however very important to have some clear ideas about the new system and the notions it is structured around.

2. What is the LMD system?

License, Master, Doctorate (LMD) system covers the institutional, the structural and the educational field. The latter remains, however, the most concerned since the whole system has undergone a renewed organization. In order to back up this reform and implement it successfully on a well built reflection at the national level the new system can be defined as follows:

- The renewal and modernization of the educational system.
- The implementation of a flexible and efficient education program enabling students to gain access to the world of work at all levels
- The reinforcement of students’ methodological, linguistic and communication skills.
- The permanent capitalization of modules and the possibility of reorientation
- The implementation of a progressive system of Students guidance.
- The introduction of continuous assessment of knowledge.
- Preparation of students for social and economic integration.

- The Organization of continuous training programs.
- The transmission of cultural values.

3. Keywords of the LMD System

The implementation of the LMD system (Bologna Process, 1999) in the Algerian universities in September 2004 has been an advancing step towards quality assurance and good governance of higher education sector. The new architecture (Bachelor's, Master's, Doctorate) offers to students increased flexibility in their programs of study, greater autonomy in their professional career development and more facilities in their mobility at the national and international level.

With the application of this new organizational scheme, new keywords have emerged:

- **The semester**

The semester is the period of time necessary to complete an actual course of study during an academic year. In the new structure, the academic year is divided into two academic semesters. A semester counts 16 weeks of study and assessment, comprises 4 modules in average and includes at least 360 hours of study.

- **The Module**

The module is the basic unit (Unité d'enseignement) of university education assigned in one semester. It consists of 1 to 2 coherent and autonomous disciplinary elements allowing an assessment of learning outcomes. Each module has a minimum of 75 hours of study (or 20 to 25 days of field work). In a modular program, courses can be taught in the form of theoretical courses and/or direct works (most of the time, these are projects) and /or workshops (T.D. /T.P.). A module is validated after student's success in continuous assessment or catch-up session.

- **Course of Study "filière"**

A course of study is a training curriculum structured in the form of coherent set of modules organized in one or several disciplinary fields. Its objective is the acquisition of skills and competencies.

The first level of a university study is a three-year program leading to the bachelor's degree. It corresponds to six semesters: 1 semester of introduction, 1 semester of orientation, 2 semesters of upgrade knowledge, 1 fundamental semester and 1 semester of specialization. The bachelor's level. Four basic units of modules are comprised in the organization of a national course of study:

- The Unit of core modules (Unité d'enseignement fondamentale: UEF) consisting of major modules reflecting the disciplinary nature of the course and minor or complementary modules "modules of support",
- The Unit of optional modules (Unité de Découverte: UED), comprising modules of specialization or openness. The modules of this bloc are left to the choice of universities.
- The Unit of transversal modules (Unité Transversale: UET), composed mainly of modules related to language, communication and computer science. The title of the module reflects the content of its lessons.
- The Unit of methodology modules (Unité de Méthodologie: UEM), comprises modules related to the University scientific researches for instance the research methodology, the dissertation research methodology, and the bibliography research methodology.

- **Accreditation**

Within the framework of the pedagogical reform, the elaboration of a course should obey to academic rules and fulfill the requirements of insertion in the economical field in order to be accredited. The modules, which are the components of a course of study, should meet standards established by the higher education community and be structured according to educational objectives enhancing, thus, the quality of the student learning.

The process of accreditation is applied to each course according to the following steps: Approbation of institution council (Faculty or school), approbation of university council and accreditation by the National Commission for Accreditation and Coordination of Higher Education.

- **Validation**

The assessment of knowledge, skills and competencies are the key cornerstone of the new educational system. In the LMD architecture, the assessment of student's acquisition and learning is semestrial and not annual. This mode of evaluation is more rational on the educational level, since it gives more emphasis to the interactive relationship during the course rather than the simple exercise of memory. Such a method of assessment equips the student with the required tools since it is organized in a wide range of exams namely tests, presentations reports.....etc in addition to a possible catch up test.

In order to progress in his university studies, the student should validate modules. A module is validated if its global mark is superior or equal to 10 out of 20 and without any mark lower than a given threshold(5/20 in general) in its composing elements.

- **Capitalization**

The capitalization is an innovative educational principle which consists of lifelong recognition of student's ownership of a validated module. The lifelong accumulation of credits allows, on the one hand, a more rational management of student's stages of university progress and, on the other hand, the establishment of functional links between the university and the professional career by giving the student a ceaselessly possible return to the university.

4. Tutoring

According to the official and governmental journal of the Algerian Republic (JORADP N°23 of May 4th, 2008: articles: 33, 34, 35,) it is stated that among the different tasks the university teacher has to fulfill there is the tutoring task. It is then stated that the teacher is to receive the students three (03) hours/week to council/advise and orient them. This task, although clearly stated has been worked with differently in most of our departments (University of Bejaia). Some consider these three hours as optional, others think they are taken as extra hours; but most of them think one hour tutoring per week is what utmost could be done. So much so, this article has been directed to focalize on the pedagogical decisions based on implementing and considering the training and tutoring sessions as a necessity to develop first the teaching craft and then help, advise and guide our students towards more success in their studies.

5. Considerations regarding Tutoring and Training in higher education

Improving outcomes for students at risk of education failure is a major concern of government, communities, and school systems. Students who do not develop the necessary academic skills are at risk for continued education failure, underemployment, and the inability to participate fully in society (Hock et al., 2001). In an effort to improve academic achievement in youth, there has been an increase in programs that provide additional educational support. Increasingly, efforts have turned to after-school (and sometimes during-school) tutoring programs which include services ranging from homework assistance to one-on-one strategic skill building. Indeed, some Mentoring, observing and interviewing are three important strategies in developing a tutoring program to develop students' learning skills and teachers' professional competences and understanding. Furthermore, a review of the literature demonstrates that tutoring programs have shown some promise in reducing the gap in achievement and increasing students' academic success. Supplemental one-on-one instruction has been shown to be an effective avenue for increasing student achievement, especially for students at risk for academic failure. Evidence also indicates that well-designed tutoring programs using trained volunteers and non-professionals can be effective in improving children's reading skills (U.S. Department of Education, 2001). Tutoring models vary and can focus exclusively on homework assistance, skill-building, or some combination of both. Depending on the type of tutoring program, specific outcomes can also range from acquiring new skills to increasing homework assignment completion (Hock et al., 2001). Tutoring programs also vary in the types of tutors they employ: community volunteers, same-age or older peers, and certified teachers.

An overview of the research on tutoring highlights a number of specific practices that appear to increase the quality of tutoring programs and improve the chances of achieving positive impacts for students. Based on the available research, Gordon (Gordon et al., 2004; Gordon, 2009) has developed key best practice strategies for tutoring programs:

- Training tutors, especially novice tutors, on effective instructional strategies is critical to providing an effective tutoring program.
- A diagnostic/developmental template should be used to organize the tutoring program for each student.
- Formal and informal assessment needs to occur for each student to guide the tutoring process.
- Tutors should track the progress of students in order to adjust their content and strategies to improve tutoring sessions.
- Tutors should closely collaborate with the students' classroom teacher to maximize tutoring effectiveness.
- Tutoring programs should be structured around principles of learning and follow a sequentially arranged approach.

5-1- Why Tutoring?

Tutoring is the process of getting students to become independent through questioning. Tutoring should help students develop self-confidence and improve study skills. In addition, the tutoring session should provide students with an opportunity to speak up and ask questions, an opportunity sometimes unavailable or missed in a regular classroom situation.

Tutoring is a well-balanced question/information exchange in which both parties participate and, therefore, both benefit. Tutoring provides the practice and drill in specific course material needed by the student, while giving the tutor valuable review opportunities and the chance to develop and sharpen educational and communication skills.

Tutoring is not teaching. There are important differences between the role of the tutor and that of the classroom teacher. Approaches, relationships, and techniques are different. The tutor works in very close proximity with the student, usually one-on-one. The student may not be accustomed to the close contact and the interchange that occurs during a tutoring session. The tutor may have to consciously strive to develop a good rapport with the student within this environment. Therefore, and according to these strategic elements and explanations, we can add that the following statements reinforce our understanding of what tutoring is actually and mostly why introducing and designing tutoring sessions in our universities appeal and need great engagements. As a matter of fact:

- Strategic tutoring reveals to be effective in improving the academic performance of the majority of participating students (Hock et. al., 2001).
- In a synthesis of research, out-of-school-time programs have been shown to have positive effects on reading in low-achieving students (Lauer et al., 2004).
- Out-of-school-time programs that provide one-on-one tutoring appear to be particularly effective for improving reading achievement (Lauer et al., 2004).
- An after-school tutoring program in which low-achieving students were tutored for one hour twice each week by university teachers generate strong improvements in the tutees' reading skills. (Morris, Shaw and Perney, 1990).
- Wasik and Slavin (1993) reviewed five one-on-one reading tutoring programs and concluded that all of the programs found significant positive effects (Elbaum et al., 2000)
- Tutoring programs can focus on activities in addition to academics (such as social enrichment) and still be effective (Lauer et al., 2004).

5-2- Setting Up the Tutoring Session

It is important to shape and organize the tutoring environment and sessions. According to the official texts, (Journal officiel de la République Algérienne N°23 du 4 Mai, 2008 ; articles 33,34, 35, ...) it has been clearly notified that university teachers are to receive the students 3 hours/week to advise and orient them. This can be difficult in the busy foreign Language teaching and learning syllabi; however, it is also very important to consider the tutoring scheduling as part of the syllabi for the reasons that not only the students are foreign language learners and that practicing the language taught and learnt outside the educational institutions is quasi not functioned with; but because the language teaching and learning processes are based on the language sciences, its culture and its literature. This is why if you follow these simple procedures, you will have a successful session.

- Get prepared for the tutoring session: A proper and a sound tutoring environment with quiet surroundings, minimal distractions, ample lighting, fresh air, and comfortable temperature is very important, and it is your responsibility to provide it. The environment in which the tutoring takes

place can mean the difference between success and failure. the right time, and mainly enough information about the student to be tutored are also necessary for good tutoring sessions,

- Prepare a greeting and review expectations bearing in mind that each greeting will differ depending upon how well you know your tutee. It is your job to make each tutee feel comfortable. Greetings and introductions are an excellent way to accomplish this. Tell your tutee a little bit about yourself. Mention your major hobbies, interests, and anything else that could help your tutee get to know you as a person, not only this can be considered as “a breaking the ice and walls” between you and the student as the tutoring session may be considered as a medical consultation, I.e.; the student is expected to express his feelings, wounds and incapacities in the learning process; but it is a way of paving the way to progress, self-confidence and studies community integration as well. Likewise, find out about your tutee’s interests, hobbies, etc...Not only will you get to know your tutee better, but often, during a tutoring session, you can relate material directly to your tutee’s hobbies and interests. This could make the material much more easily understandable to your tutee. If Applicable, take a look at the class syllabus and text. A class syllabus can often help in planning for future sessions.
- Be prepared for potential problems: consider the first tutoring session as the preliminary phase to gather data about the student. Knowing well about the student not only renders the tutoring task easier and well achieved through assessing his understanding of the subject by asking questions, determining his needs for success in the subject and suggesting strategies in which to fully and actively engage him to foster learning autonomy; but enables the student be more fluent and more confident. The communication techniques and skills that you demonstrate as a tutor can significantly impact the session. Communication also plays an important role in creating an environment in which your tutee will never feel embarrassed or “dumb” during a session. For the success of these strategies, the tutor had better not to lecture but attempt to use good questioning techniques, select some positive ways of correction and problem solving.

Methodology

The art of questioning is arguably one of the most important skills for tutors to develop; when employed thoughtfully, questions can become an effective teaching strategy. A timely, well-phrased question can stimulate and deepen thinking, enable us to assess students’ progress, check on our clarity, motivate students, maintain control, or emphasize key points. Different kinds of questions ask our students to display different kinds of knowledge. But good questioning is not always something that comes naturally. The ability to develop adequate or even excellent questioning skills can be learned if some attention and practice is given to it especially when we are called to properly devote our time for tutoring students in need, and this section is dedicated to the methodology used in order to gather reliable data about the tutee taken as our research paper sample population and a case of study to elicit consistent responses. Our investigation has been based on the research design we meant: identifying the student’s needs in terms of

- Ownership -- whose needs are they?
- kinds – personal, learning and future professional needs; and
- Sources – where does the need come from?

Procedure**The preliminary phase**

The first task of the tutoring session with Abdenmour has been to assess his needs for a tutoring program. This assessment and investigation has included an inventory of the current student's initiatives and difficulties with an indication of their nature and scope, in order to measure existing services which might meet these needs, and to pinpoint the gaps to be filled by the new program which has been built on the student's skills and interests providing thus activities of direct benefits. For this task, the principle of honesty has been of great importance as we informed our tutee that we did not have answers for all the problems but would not stop there. We added that the tutee was permitted to consult another tutor for such circumstances as we strongly believed that it is possible that the answer can be discovered with a little research getting the tutee involved. Furthermore, we found it appropriate to challenge our tutee to do some work or research on the problem and present his work at our coming session making him know that we were listening by verbally acknowledging our tutee's situation.

Defining the mission

The next step for our tutoring session was to define the tutoring program's overall mission; a brief statement describing what the program intends to do to address the identified need. In developing the mission statement, we considered the important contributions to supporting our tutee's literacy development made by his family as we have had the opportunity to meet his father in our office and had long discussions about many topics which were directly related to our tutee's health, determination to carry on his studies, to succeed and his devotion to engage into activities challenging his handicap. The mission statement guided us towards suggesting at the very first stage, to offer our tutee a recorder "Dictaphone" with setting goals and objectives as most of his teachers complained about frequent courses interruptions, frequent but pertinent questions during courses delivery and, according to these teachers, the situation hindered their courses progress

Design the program


The program design described how the tutoring program would carry out its mission and achieve its goals and objectives.

In designing the program, we needed to discuss and answer questions such as the following:

- How will the student in need of tutoring be identified?
- How and when will the program conduct pre- and post-investigation?
- How will the program ensure that student who needs special education and care or other services, in addition to or in place of tutoring, will receive such help?
- Where and when will tutoring take place?
- How will the program ensure that tutoring services delivered to the student during the regular school day are beneficial and outweigh missing regular classroom activities? How will the program track the student's progress?
- How will the program support the tutors

Get it started

A flexible format with instructional goals which we gathered from the tutees' teachers to increase his motivation for learning, allowed us to use strategies that seemed tailored to address his learning style, skills, interests, and needs. This flexibility ensured that our student would receive individualized and developmentally appropriate support and would encourage him to think about what he might learn during the planned tutoring sessions. Not only this; but he might involve talking or making comments that we would write down.

Ownership	Kind	Source
 <p>Abdenmour FERKAL</p>	personal needs	<p>Age: 23 years old</p> <p>Sex : Male</p> <p>Cultural background: good in scientific fields, languages: Arabic, French, English and Kabyle.</p> <p>Interests: Listening to music, playing guitar, walking, joking</p> <p>Educational background : University level (3 SLD)</p>
	learning needs	<p>Learning styles: auditory and tactile</p> <p>Previous language learning experiences: only what I have learned during my educational curses (intermediate and secondary schools).</p> <p>Gap between the target level and the present level in terms of knowledge (e.g. target language and its culture): I need to reinforce knowledge about the language I am actually studying and its culture ; for this, teachers and all the educational community as well as my family should find out strategic techniques based on sound recordings to help me take profit from what I have been missing till now (recorded documentaries in English, recorded, books/novels/magazines/plays whose themes are related to my target objectives)</p> <p>Gap between the target level and the present level of proficiency in various competence areas (e.g. skills, strategies): Since the technique used to grasp, follow, understand and assess the knowledge I acquire through the different credits is mainly based recitation, memorization and peer-review based, honestly, it is with the credit: research methodology that I generally encounter the most difficult situations.</p> <p>Learning goals and expectations for a course: first to succeed in my studies so as to be prepared for the professional phase. As far as the course is concerned, I expect some more attention</p>

		to special students as to vary the techniques and strategies of teaching and delivering the courses.
	future professional needs	<p>Requirements for the future undertakings in terms of:</p> <p>Knowledge of language: more speaking skill sessions</p> <p>Knowledge of language use: more activities in the writing skill not only giving theories</p> <p>FL competence: performance and reinforcement in the writing and the speaking skills.</p>
	Expectations from the tutoring sessions	<ul style="list-style-type: none"> - find out solutions/suggestions to personal difficulties: - My difficulties are most of the time around my studies. Therefore, I need to have more organized and frequent tutorials from all my teachers. And more handouts. - find out solutions/suggestions to learning difficulties - Note taking through recording what the teachers are being explaining or thanks to my classmate who will read the notes for me. - Memorizing even if this is not always easy for me, I want to find out new ways which will help me memorize better and keep in mind the most important elements of the different courses I have. - Time management: there is quiet a good management of my personal time. This is not the case for my studies as I cannot have enough time to have a rest nor to digest what has been taught. I feel like I am in a continual rush, no break between the different modules, adding to this the place where we our courses take place are far and each lecture is designed in a far and different classroom or amphitheatre. - Potential problems (learning materials, learning aptitudes through recitations,)

We have been able to achieve this work through designing a “Tutoring Report” represented as follows:

Tutoring dates and hours	Special materials to incorporate	Research –based interventions and activities	Data collected to monitor the student’s progress	Suggestions for compensation	Tutor’s impressions of the student’s progress in the program
Sunday 11:15 to 2pm Three time since October 2012	A recorder, hand outs,	Reading, rehearsing/repeating and memorizing through question asking	Need t be tutored several times a week, need to repeat each time the same previous activities before moving forward, need to prepare and afford a sound, cal m and fresh environment	Ask for peer and teachers’ help, design some peers to read the hand outs and organize group work activities based on summarizing short passages of the material provided by teachers through reading activities , record a soft and warm teacher’s voice to capture the student’s attention and help in his concentration, devote more time listening activities, work on easy modules to afford more time to the most difficult ones, create a balanced schedule between modules of high coefficients	Very difficult to be engaged in such activities but some signs of progress start to appear.

6- The impact of tutoring on professional development

Qualified tutors are a critical element in the success of any tutoring program if this ensures that they have the knowledge and skills needed to carry out their roles effectively through methods such as workshops, group meetings, and on-site visits. In the Algerian Universities, there is no special tutor qualification; university teachers play both roles: teaching and tutoring. Furthermore, training and supervision of the students' needs for tutors not only acknowledge and build on experiences, provide information that can be used immediately, but allow for practice and skill development as well. Since tutoring addresses a range of topics; however, all will be tied to effective implementation of the teaching and learning curriculum. In a nutshell, the following table illustrates better the positive impacts of the tutoring on the teaching professional development and this through demonstrating that both tasks are completing and reinforcing each other:

Tutoring	Teaching
<p>Based on a tutoring approach which is:</p> <ul style="list-style-type: none"> • The learning curriculum used by the tutoring program • The learning approach used by the educational system • Tailoring the curriculum to address individual needs, planning sessions for interaction, communication, involvement, critical thinking, motivation, production, • Assessing the students' learning abilities and tracking their progress as tutors play an important role in the assessment of students' work and in ensuring that students receive helpful feedback on their work, • Ongoing training and supervision of the students • Resources (materials, books, workshops, web sites, list serves), • Strategies for handling problem situations • Coordinating with tutoring program partners • Following the tutoring program's policies and procedures, • Not focusing the session on small grammatical concerns. May address one or two issues by teaching the students about the problem, but will not make changes for them. 	<p>Based on a teaching approach which is:</p> <ul style="list-style-type: none"> • The Teaching/ learning curriculum designed by the educational syllabus • The learning approach used by the educational system • Tailoring the curriculum to address individual needs, planning sessions for interaction, communication, involvement, critical thinking, motivation, production, • Assessing the students' learning abilities and tracking their progress as teachers play an important role in the assessment of students' work and in ensuring that students receive helpful feedback on their work, • Ongoing training and supervision of the students, • Resources (materials, books, workshops, web sites, list serves), • Strategies for handling problem situations, • Coordinating with peers • Following the higher education program's policies and procedures, • Tutors do not tell students what kind of grade they can expect on their paper. This decision is for course instructors and teaching assistants to make.

In addition to the aforementioned elements, both teachers and tutors need continuing support not only in addressing the students' needs; but students with severe learning difficulties. At this stage, training should address the multiple factors that contribute to such learning difficulties and the tutoring as well as the teaching strategies are of vigor in helping students gain the skills needed to learn. As the development process of the teaching and the tutoring activities moves from planning to implementation, to assessment, to readjustment, both sides continue to provide input related to their areas of expertise.

7- Recommendations and Conclusion

Teaching and tutoring are actually the primary vehicle through which students are afforded an opportunity to develop and demonstrate key generic skills, such as critical thinking or team work. Well-formulated and delivered teaching/ learning and tutoring processes ensure that students have clear expectations of what's required of them, and are an important tool for teachers to use to stimulate the type of learning that they want their students to achieve in addition to enable teachers reflect on their teaching craft as an active process of attending to their own experience of teaching in order to explore it in some depth. Furthermore, Teaching and tutoring present a powerful opportunity to learn through reflection, to improve the educational experiences provided for students and to identify the professional education needed to further develop the capacity to teach well. Other elements as mentoring, observation and interviews are actually important strategies in developing teachers thanks to which teachers and tutors will be able to draw on a wide range of relevant experiences, strategies and techniques from other aspects of their work. A teacher's ability to impact student learning is directly related to high-quality, sustained professional development in a collaborative and collegial learning community.

Finally, we cannot but focus on the fact that there is more than one "right way" to tutor, and there are plenty of "wrong ways" as well. Anything the teachers do as tutors that gets positive results is a "right way" of tutoring. Teachers have to be creative and not be afraid to try new ways of presenting skills, processes, or material because what works with one tutee may not work with another.

Encouragement, Patience, understanding, and praise are other effective ingredients to teaching and tutoring as we strongly believe that when students feel welcome, accepted, safe, listened to, valued and confident this can help increase the students and tutees self-esteem and actually produce independent and autonomous learners. And the goal of an effective tutor and an effective teacher is to develop protagonist in setting the culture of the tutorial and teaching processes and thus set parameters for creating a learning culture and environment which recognize and honor students' diversity.

References

- Bryant A. L., Schulenberg, J., Bachman, J. G., O'Malley, P. M., & Johnston, L. D. (2000). Understanding the links among school misbehavior, academic achievement, and cigarette use: A national panel study of adolescents. *Prevention Science* 1(2), 71-87.
- Chapman, E. (1998). Key considerations in the design and implementation of effective peer-assisted learning programs. In K. Topping & S. Ehly (Eds.), *Peer-Assisted Learning* (pp. 67-84). Mahwah, NJ: Lawrence Erlbaum Associates.

- Cohen, P. A., Kulik, J. A., & Kulik, C. L. C. (1982). Educational outcomes of tutoring: A meta-analysis of findings. *American Educational Research Journal*, 19(2), 237-248.
- Elbaum, B., Vaughn, S., Hughes, M. T., & Moody, S. W. (2000). How effective are on-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology*, 92(4), 605-619.
- Gordon, E. E., Morgan, R. R., Ponticell, J. A., & O'Malley, C. J. (2004). Tutoring solutions for No Child Left Behind: Research, practice, and policy implications. *NASSP Bulletin*, 88(638), 59-68.
- Gordon, E. E. (2009). 5 ways to improve tutoring programs. *Phi Delta Kappan*, 90(6), 440-445.
- Hawkins, J. D., Catalano, R. F., & Miller, J. Y. (1992). Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin* 112(1), 64-105.
- Jenkins, J. R., & Jenkins, L. M. Making peer tutoring work. (1987, March). *Educational Leadership* 44(6), 64-68.
- Juel, C. (1996). What makes literacy tutoring effective? *Reading Research Quarterly*, 31(3), 268-289
- Hock, M. F., Pulvers, K. A., Deshler, D. D., & Schumaker, J. B. (2001). The effects of an after-school tutoring program on the academic performance of at-risk students and students with LD. *Remedial and Special Education*, 22(3), 172-186.
- Houge, T. T., Geier, C., & Peyton, D. (2008). Targeting adolescents' literacy skills using one-to-one instruction with research-based practices. *Journal of Adolescent & Adult Literacy*, 51(8), 640- 650.
- Koralek, D., & Collins, R. (1997, December). *On the Road to Reading: A guide for community partners*. Washington, DC: The Corporation for National Service. Retrieved December 15, 2004, from www.ed.gov/pubs/RoadtoRead
- Lauer, P. A., Motoko, A., Wilkerson, S. B., Apthorp, H. S., Snow, D., & Martin-Glenn, M. (2004, January). *The effectiveness of out-of-school-time strategies in assisting low-achieving students in reading and mathematics: A research synthesis*. Aurora, CO: Mid-continent Research for Education and Learning. Retrieved on January 7, 2009, from <http://www.mcrel.org/topics/products/151/>
- Madden, N. A., & Slavin, R. E. (1989). Effective pullout programs for students at risk. In R. E. Slavin, N. L. Karweit, & N. A. Madden (Eds.), *Effective programs for students at risk* (pp. 52-72). Boston: Allyn and Bacon.
- Maheady, L., Mallette, B., & Harper, G. F. (2006). Four classwide peer tutoring models: Similarities, differences, and implications for research and practice. *Reading & Writing Quarterly*, 22, 65-89.
- McArthur, D., Stasz, C., & Zmuidzinas, M. (1990). Tutoring techniques in algebra. *Cognition and Instruction*, 7(3), 197-244.
- Morris, D., Shaw, B., & Perney, J. (1990, November). Helping low readers in Grades 2 and 3: An afterschool volunteer tutoring program. *Elementary School Journal*, 91(2), 133-150
- Reisner, E. R., Petry, C. A., & Armitage, M. (1990). *A review of programs involving college students as tutors or mentors in grades K-12*. Washington, DC: U.S. Department of Education.

- Robledo, M. Del R. (1990). *Partners for valued youth: Dropout prevention strategies for at-risk language minority students*. Washington, DC: U.S. Department of Education.
- Schinke, S. P., Cole, K. C., & Poulin, S. R. (2000). Enhancing the education achievement of at-risk youth. *Prevention Science* 1(1), 51-60.
- U.S. Department of Education. (2001). *Evidence that tutoring works*. Washington, DC: Office of the Deputy Secretary, Planning and Evaluation Service, USDOE.
- Warger, C. L. (1991). *Peer tutoring: When working together is better than working alone*. Reston, VA: Council for Exceptional Children.
- Wasik, B. A., & Slavin, R. E. (1993). Preventing early reading failure with one-to-one tutoring: A review of five programs. *Reading Research Quarterly* 28(2), 178-200.

Innovation in Manufacturing Industries and The Use of Industrial Property in Brazil

Rodrigo Rocha P Lima, Suzana Russo
FEDERAL UNIVERSITY OF SERGIPE
Brazil

Abstract

Innovation is a key issue for business and in the current scenario of even more fierce competition, industries need to accelerate more and more the introduction of innovative knowledge and practices in order to stay in the market. In view of this environment, it is imperative that the Brazilian manufacturing industries improve their innovative processes, and it is also necessary to strengthen the use of industrial property. This study aims to know the context of innovation in the Brazilian manufacturing industries and the use of industrial property in Brazil. In the initial part, a theoretical research (discussion by theory) was carried out and then the descriptive and exploratory methodology was used, using a set of information and data collected from research and studies provided by institutions of national and international relevance. Based on the study, it was possible to draw a detailed profile of the innovative environment of the Brazilian manufacturing industries, whose main challenge is the high costs of innovation and the most important impact is the maintenance of the companies' participation in the market. It was also verified the low use of industrial property by the business segment.

Keywords: Innovation; Manufacturing Industries; Industrial Property

1. Introduction

Innovation has a strategic role for business competitiveness, even more so in a scenario like the current highly fierce competition. Despite this, the theme does not have the necessary protagonism in Brazilian development policies. This finding can be seen through the environment that is not very stimulating to innovation, where the establishment of institutions, connections and instruments is very slow vis-à-vis the accelerated process existing in other countries (CNI, 2018; CORNELL, INSEAD AND WIPO, 2017)

In Brazil, historically, innovation and technology have been treated as a consequence of economic growth, instead of being treated as inducing economic and social development. In view of this scenario, it is urgent to break this logic, through the creation of a set of strategic actions that make the environment more conducive to the emergence and strengthening of innovative initiatives that enable the economic transformation of the country, towards a model that sustains development over time. (CNI, 2018; UNIVERSIDADE CORNELL, INSEAD E WIPO, 2017).

In addition to a more stimulating external context, the internal environment of companies must also enable innovation to occur successfully. The way in which the most important factors of any company

(employees, financial resources, structure, among others) are directed, is that it will allow the creation of an internal climate favorable to the desired innovative results (FARIA and SOFIA, 2012).

In companies that seek to make a more structured management of innovation, Industrial Property deserves mention, as it is an efficient way to protect investments made for the development of new products, services and production processes (IEL, 2010).

In view of this scenario, in which companies have more than one desire, but a real need to innovate, this study has as its general objective to know the innovative environment existing within the Brazilian transformation industries and the existing relations with the external environment, also raising indicators on the use of industrial property in Brazil, making it possible to identify important actions to accelerate the business innovation process in the country.

To achieve the objectives of this study, the methodology used in the initial part was theoretical research (discussion by theory), where the main concepts related to innovation were presented, possible ways to implement an innovation management model and more relevant concepts about ownership intellectual property and industrial property.

Then, a descriptive and exploratory analysis was made, using a set of information and data collected from research and studies made available by institutions of national and international relevance. The Innovation Survey (PINTEC, 2014) for the 2012-2014 three-year period, carried out by the Brazilian Institute of Geography and Statistics - IBGE, which was used because it is the most recent national research, most recent on the subject, and for have a great level of details, allowing the characterization of the innovative environment of the Brazilian transformation industries. Still in the analysis of the results, relevant indicators on the use of industrial property in Brazil were presented, made available in the reports and databases of the National Institute of Industrial Property - INPI. Finally, the main results were discussed and the final considerations were presented.

2. Innovation in the Business Context

For Schumpeter (1982), innovation is different from the simple economic adaptation that happens naturally and originates from discontinuous changes, being characterized as a change that occurs internally and not through external pressures. According to the author, a creative destruction occurs that allows the generation of new combinations of the productive factors, enabling the increase of productivity.

To survive in Schumpeterian environments, organizations must be able to cope with the increasing complexity and changes that occur with great speed. In these contexts, companies with the capacity to innovate will be able to respond to challenges more quickly and explore new products and market opportunities, better than non-innovative companies. Innovation helps the company to deal with the turbulence of the external environment and is a strong driver of growth and organizational development, therefore being one of the main drivers of long-term success in business, particularly in dynamic markets (Jiménez-Jiménez & Sanz -Valle, 2011; Bonazzi & Zilber, 2014).

To understand how innovation is approached within the business reality, it is worth highlighting one of the most widespread concepts globally, among companies and institutions that encourage the expansion

of innovative actions, which is the one given by the Organization for Economic Cooperation and Development (OECD), in the Oslo Manual, translated into Portuguese and made available by the Financier of Studies and Projects (FINEP):

A implementação de um produto (bem ou serviço) novo ou significativamente melhorado, ou um novo processo, ou um novo método de marketing, ou um novo método organizacional nas práticas de negócios, na organização do local de trabalho ou nas relações externas (OCDE, 2005, p. 55).

Often, the implementation of one of these types of innovation can be accompanied by other types, triggered by the need to adapt other areas of the business to the main change (Mattos, Stoffel & Teixeira, 2010).

Innovation can be classified as radical or incremental. The radical is due to the structural rupture in the current pattern, which may cause the emergence of new sectors, markets and economic activities. Incremental innovation improves the existing standard and does not generate structurally significant changes. Despite this, it can be considered that these two forms of classification are actually part of a larger context, where they are complementary during the cycle of the innovative process (Dosi, 1988; Aleixo & Tenera, 2009; Souto, 2015).

It is worth highlighting the relevant difference between innovation and invention. If there is no “Result”, that is, if it does not generate a market impact, the invention will not be considered an innovation, but, on the other hand, there may be innovation without the need for the invention, which may occur by simply reconfiguring the use of resources (human, technological, etc.). In many cases, the invention does not reach the market, as it has no real use and in other cases it takes many years to become economically viable and finally become an innovation. Thus, innovation is directly related to market success. Mattos, Stoffel and Teixeira (2010) propose the following theoretical model to define innovation (Figure 01):

INNOVATION = IDEA + IMPLEMENTATION OF ACTIONS + MARKET RESULTS

FIGURE 01 - Theoretical model of innovation.

Source: Adapted from Mattos, Stoffel and Teixeira, 2010

It is important to note that innovation is not limited to high-tech sectors. It is a global event that affects all segments, as well as companies of all sizes, and can play a highly relevant role in overcoming the challenges of economic development. Based on the definition of the OECD (2005), it appears that it is possible for any company to find ways to innovate, and it should be seen as fundamental for sustaining the market, as it allows for the expansion of competitiveness (Cornell University, Insead & WIPO, 2017; Vargas et al, 2016).

Although innovation can occur in many ways, technological competition deserves to be highlighted, which challenges organizations to develop new technologies, being an important way for companies to obtain sustainable competitive advantage. The new technological knowledge enables new products to enter the market and new processes to be applied to the enterprise (Yang et al, 2015; Ramos, Figueiredo

& Pereira-Guizzo, 2018).

Undoubtedly, innovation is the factor that most allows companies to remain competitive in the current competitive scenario where, more than a simple need for survival, it makes it possible to plan for the future, through the ability to reinvent and generate leadership opportunities in the segment medium in the medium and long term (Mello et al., 2013).

In view of this reality, in order to be able to improve the desired innovative results for the country, continuous efforts are needed to stimulate the improvement of environments aimed at generating innovations (Cornell University, Insead & WIPO, 2017).

2.1 Innovation Management

In order for innovative efforts to effectively generate results, it is essential to understand which processes and factors guide the most correct business decisions regarding innovation, generating greater efficiency in the use of resources and capacities during the execution of business strategies (Kenski & Marcondes, 2017).

According to Rita et al. (2010), companies that adopt structured processes of accumulation of learning, to direct their actions in innovation, reduce uncertainties and have greater potential for success over time.

There are many studies on ways to innovate successfully, and there have been changes over the past few decades on best practices for achieving good results. Despite this, innovative companies did not automatically follow the models prescribed as dominant in their time, verifying that, often, success is based on how to manage the innovation process in its specific context (Ortt & Duin, 2008).

Understanding the various paths of innovation management (and their respective advantages and disadvantages) is a prerequisite for selecting the best model for each reality. It is important to know the context and the mechanisms that determine the decision-making process, as what is usually verified is that companies develop a path in which their management practices adapt to their business, being called contextualized innovation. In view of this, there is a need to create not a single model, but a range of paths, which offers companies several possibilities to manage their innovation process (Ortt & Duin, 2008).

One way that companies can follow to start the innovative process is through the generation of a significant number of high quality ideas, in order to obtain a balanced portfolio of innovative projects with potential for success. However, it is necessary to select and prioritize ideas and concepts that are strictly promising, due to the scarcity of resources, which does not allow to develop at the same time all the good ideas that may arise in this process (Kock, 2015).

Companies need practical management of the portfolio of ideas to simultaneously support the variety and selection of ideas and concepts before entering the portfolio of innovation projects. The management of the portfolio of ideas can be guided by three elements: ideation strategy, formalization process and stimulating creativity. The three elements independently and significantly contribute to success (Kock, 2015).

For the innovation management process to be effective over time, it becomes extremely important to implement structured forms of monitoring and evaluation, such as through the creation of indicators that show whether the results achieved are being satisfactory, thus the need for identify which variables

should be measured and with which tools. Monitoring the innovation management process, with the appropriate metrics, will allow greater security in decision-making, especially those involving financial investments (Vargas, 2016).

To support the execution of innovation management, software can be counted on, which supports the union of concepts with ideas, in a creative balance that guarantees the organization's internal operations. To this end, a methodology for managing the process of generating ideas, together with software, as a support tool, can provide an adequate infrastructure for innovation (Flynn, 2003).

From the structuring and through the incorporation of scientific research, planning, problem solving and knowledge construction, it is possible to generate a favorable space for decision making and the development of innovation (Silva et al, 2014).

For all this innovative environment to work more efficiently, one of the critical points is the qualification of the people involved, being necessary to have qualified employees in their respective areas, especially the managers. It is then necessary to qualify employees and, in particular, managers, which is a critical factor for planning and executing innovation processes (Faria, 2012).

The efficiency of the management of all processes that involve innovation will strongly influence the speed with which the company will be able to implement innovations, marking the competitive capacity and defining the winners (Almeida, Silva & Oliveira, 2014).

One way to facilitate the implementation of innovations is based on the open innovation model. This way of innovating, which is based on the search for external knowledge as a basis for innovation, can create competitive advantage, representing a development alternative for companies, helping them to compete in the current business environment (Silva & Dacorso, 2013).

For Esteves and Nohara (2011), the creation, sharing of knowledge and acquisition of information, through the combination of resources and capacities, are strategies that increase the probability of success of organizations, corroborating the growing trend in the formation of strategic alliances.

For this whole innovative process to happen in the companies Maçaneiro and Cherobim (2011), they highlight the importance of financing technological innovation. Conditioning factors, incentives and obstacles to access to government resources, for financing, can be decisive in the innovative process.

3. Innovation and Industrial Property

Within the context of innovation management, especially technological, a relevant theme is intellectual property, as it allows greater security in the appropriation of the economic results of innovations that have the potential to be protected according to the specific legislation of intellectual assets. Within the scope of intellectual property, within a company, come all activities related to Research and Development (R&D), such as, for example, product development, knowledge management, technology transfer, etc. (Runge, 2015).

Despite the importance of these themes, Intellectual Property is poorly understood in the business environment, and its use should be strengthened, which is much less than its potential. The World Intellectual Property Organization defines that intellectual property is related to the creations of the mind: inventions, literary and artistic works, as well as symbols, names and images used in commerce (WIPO,

2018),

According to Mendes and Borher (2012), for many decades the area of law had a great dominance in the subject of intellectual property, due to the knowledge accumulated by groups of lawyers specialized in the subject, who learned all the details necessary to defend the legal interests of companies with IP assets. Within the current economic context, intellectual property has gained a much larger space, and it is therefore necessary to attract actors from different areas of law. Areas such as science, technology, business, management, economics, among others, give the theme a multidisciplinary character (Mendes & Borher, 2012).

With the entry into force of the innovation laws in several countries, boosting in particular the interaction between knowledge centers and private and public companies, there is a great importance of the practical management of IP, so that companies can benefit from the records in the agencies competent and able to follow the ways of protecting IP assets (IEL, 2010).

According to Brazilian law, Intellectual Property can be divided into the following categories: Copyright; Sui Generes Industrial Property and Protection. From a business perspective, Industrial Property deserves special mention, as it is the branch that aims to ensure legal protection of industrial inventions; utility models; industrial designs; brands (be they product, service, certification or collective); industrial secrets and geographical indications (INPI, 2018).

INPI is the federal government institution responsible for industrial property and other fields of intellectual property of interest to the industry. This body is responsible for any and all procedures for requesting, granting and negotiating industrial property in the national territory (INPI, 2018).

Within the industrial property there are the following branches, with their respective objectives, as shown in Table 1:

Table 1 - Branches of Industrial Property and their main characteristics

Branches		objective
PATENT	Invention Patent	Technological progress
	Utility Model	Technical-functional improvement
Industrial draw		Ornamental improvement (appearance of the object)
mark		Companies and / or products
Geographical Indications		Indication of Origin and Designation of Origin

Fonte: Adapted from INPI, 2018.

As shown in the previous table, the innovations that enable technological advancement must be protected and generally this type of industrial property is the one that has the greatest possibility of generating more significant economic results. However, in order to encourage this type of innovation to occur more frequently, a favorable innovative environment is needed, therefore it is important to understand the main characteristics of the Brazilian manufacturing industries, as it is the main segment responsible for manufacturing the products that will reach consumers.

4. Innovation in the transformation industries and the use of Industrial Property in Brazil

In view of the objective of the study, an exploratory research of a descriptive nature was chosen, which sought to survey the behavior of the phenomena and obtain information based on studies and data from institutions of national and international relevance, on the theme of innovation in the transformation and the use of industrial property in Brazil.

4.1 Innovation in the Brazilian segment of the transformation industries

In 2018 Brazil occupied the 64th position (Table 01), among 127 countries, in the Global Innovation Index (GII), which measures the innovative performance of nations since 2007, being in a lower position than that occupied by several countries that have economies much more modest. This indicator shows the country's need to accelerate its investments in R&D.

TABLE 01 - Classifications in the Global Innovation Index - GII 2017 - 10 best classifieds and Brazil

Country / Economy	Score (0-100)	Rating
Switzerland	68,40	1
Netherlands	63,32	2
Sweden	63,08	3
United Kingdom	60,13	4
Singapore	59,83	5
USA	59,81	6
Finland	59,63	7
Denmark	58,39	8
Germany	58,03	9
Ireland	57,19	10
Brazil	33,44	64

Source: Adapted from Universidade Cornell, Insead e WIPO, 2018.

Given this scenario, it is important to understand the innovative reality in Brazil. PINTEC 2014 evaluated 132,529 Brazilian companies, of which 115,268 were from the manufacturing industry segment, representing approximately 87% of the total.

From this IBGE study, it appears that 36.3% of the manufacturing industries are innovative in products and / or processes, 34.1% innovate only in the organizational and / or marketing part, while 26.7% did not take any action innovative between 2012 and 2014, as shown in Figure 02.

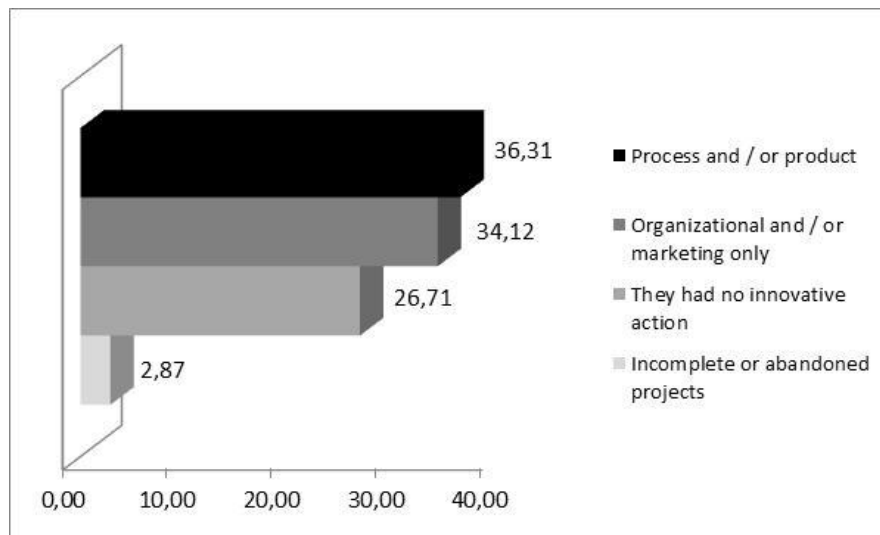


FIGURE 02 - Distribution of Manufacturing industries by type of innovation (Brazil - 2012-2014) (%).

Source: Adapted from IBGE - PINTEC / 2014.

Figure 03 shows the distribution, in percentage, of the number of innovative manufacturing industries, according to the type of innovation introduced. There is a predominance of those that innovated only in process (17.9%), followed by innovators both in product and in process (14.5%), with both types as a reference to novelty mainly for the national market.

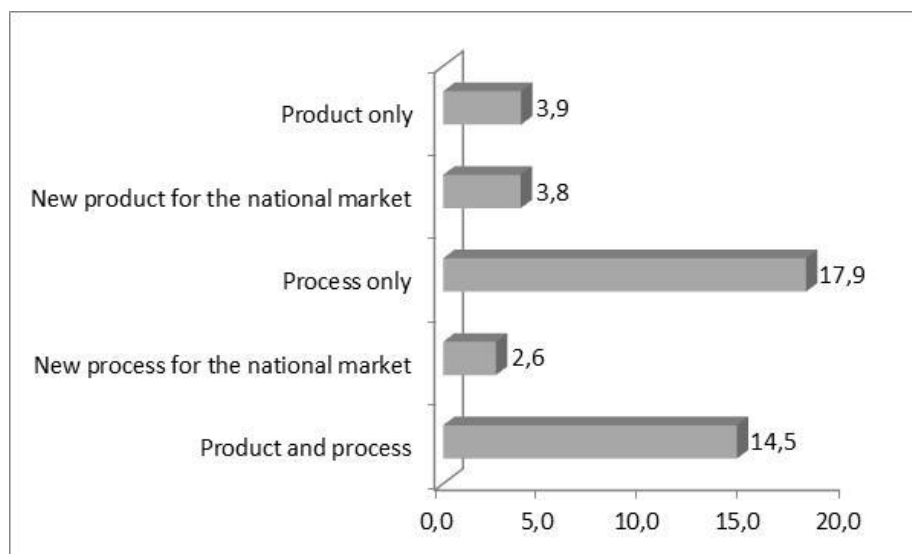


FIGURE 03 - Rate of manufacturing industries that implemented product or process innovations, by type and according to the market benchmark - (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

The most important innovative action was the acquisition of machinery and equipment, being considered as of high or medium importance by 73.6% of the industries. Next came Training (61.7%) and Software Acquisition (31.7%). See Figure 04.

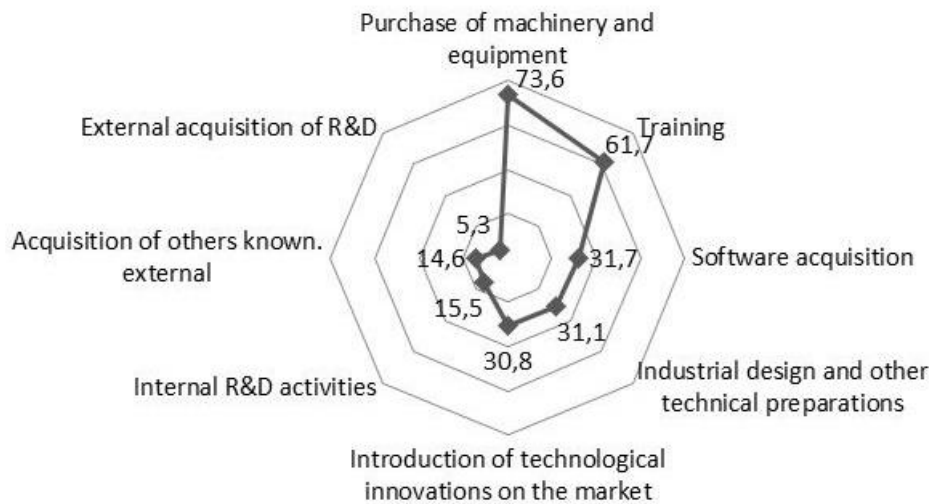


FIGURE 04 - Innovative actions developed, according to the percentage of manufacturing industries that indicated a degree of medium or high importance (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

When analyzing the rate of expenditures made in innovation activities in relation to net sales revenue, it is noticed that the total investment is 2.16% and 0.68% when it comes specifically to internal R&D activities. The acquisition of machines and equipment stands out as the most significant expense among those made with innovations, being 0.86% (Figure 05).

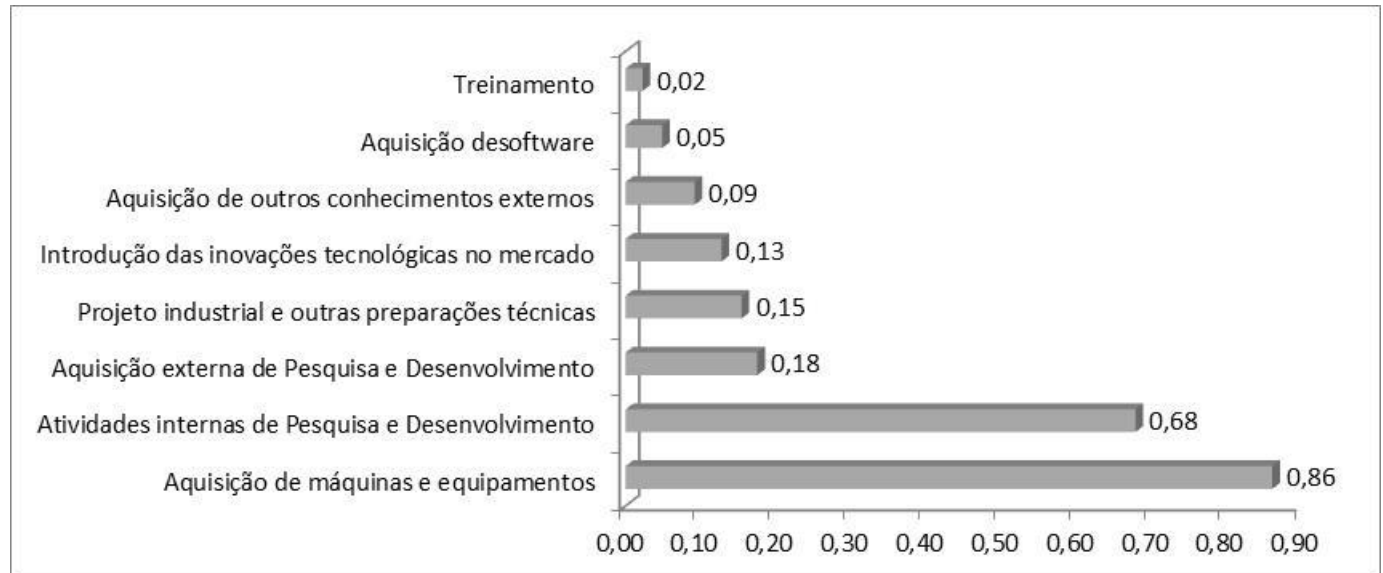


FIGURE 05 - Percentage of net sales revenue spent on innovative activities in the manufacturing industries (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

When analyzing Figure 06, it can be seen that 72.5% of the companies that implemented product or process innovation carry out continuous R&D activities, which corresponds to 96.9% of the expenditures, while 27.5% of the companies do so. occasionally, representing 3.1% of expenditures.

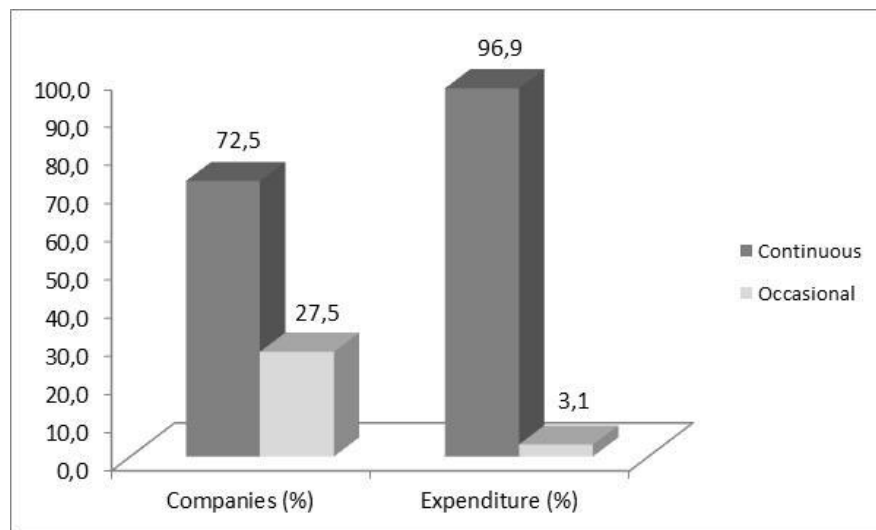


FIGURE 06 - Distribution of the manufacturing industries that implemented product or process innovations, that did R&D and the expenditures made with an indication of the nature of this activity (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

In industries that have Research and Development (R&D) areas, among the people employed in these areas, it can be seen that 60.8% are dedicated exclusively to innovative activities, while 39.2% have partial dedication, dividing their time with other activities (Figure 07).

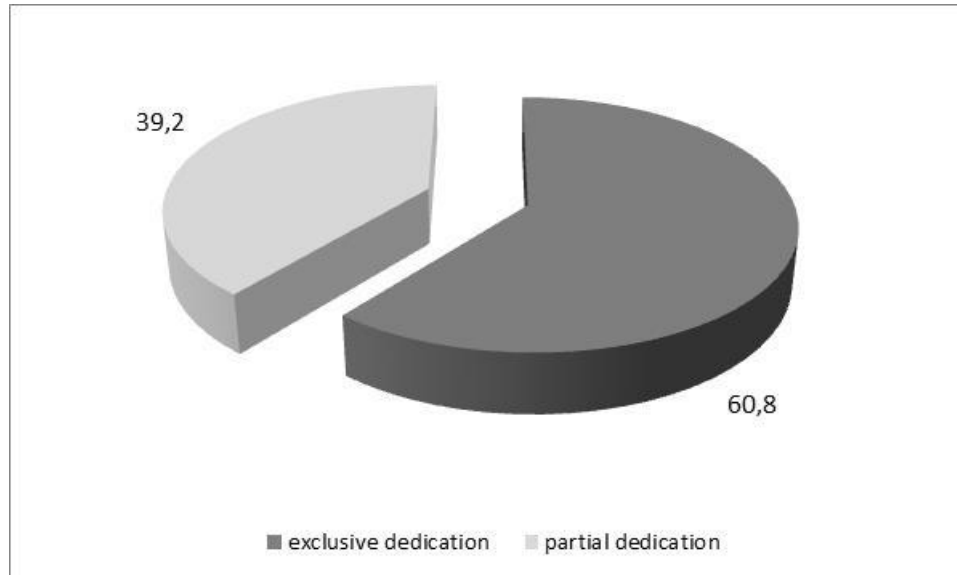


FIGURE 07 - Participation of employed persons, by type of dedication, in the R&D activities of the manufacturing industries, Brazil - 2014 (%).

Source: Adapted from IBGE - PINTEC / 2014.

Among people engaged exclusively in internal R&D activities, most are researchers (66.1%), followed by technicians (25.5%) and finally assistants (8.4%). See Figure 08.

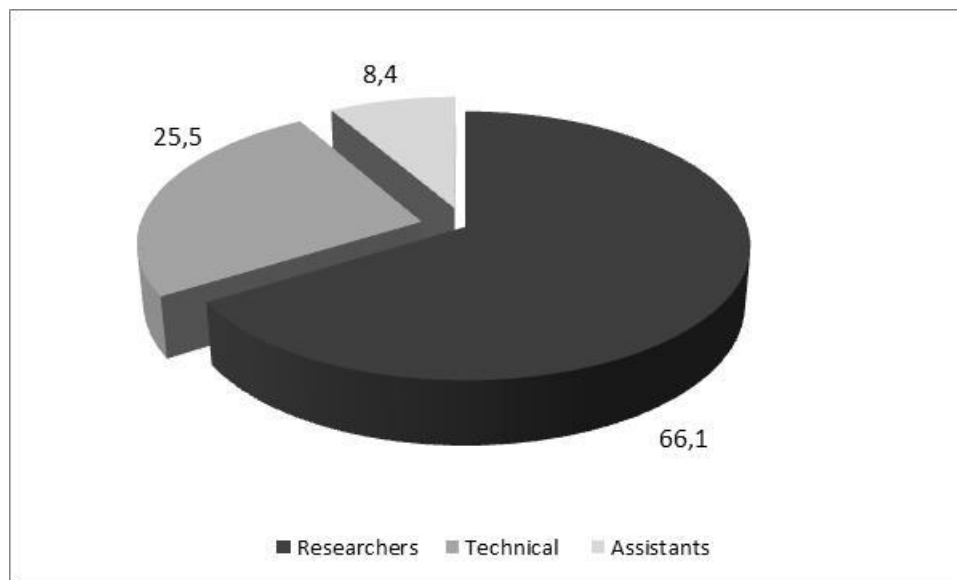


FIGURE 08 - People employed in internal Research and Development activities, with total dedication equivalence, of the manufacturing industries that implemented innovations, by occupation (%) - (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

The alternative identified as the most important source of information is the Computerized Information Networks, having high or medium importance for 78.8% of the industries. Next came Customers and consumers (73.3%) and Suppliers (70.5%). See Figure 09.

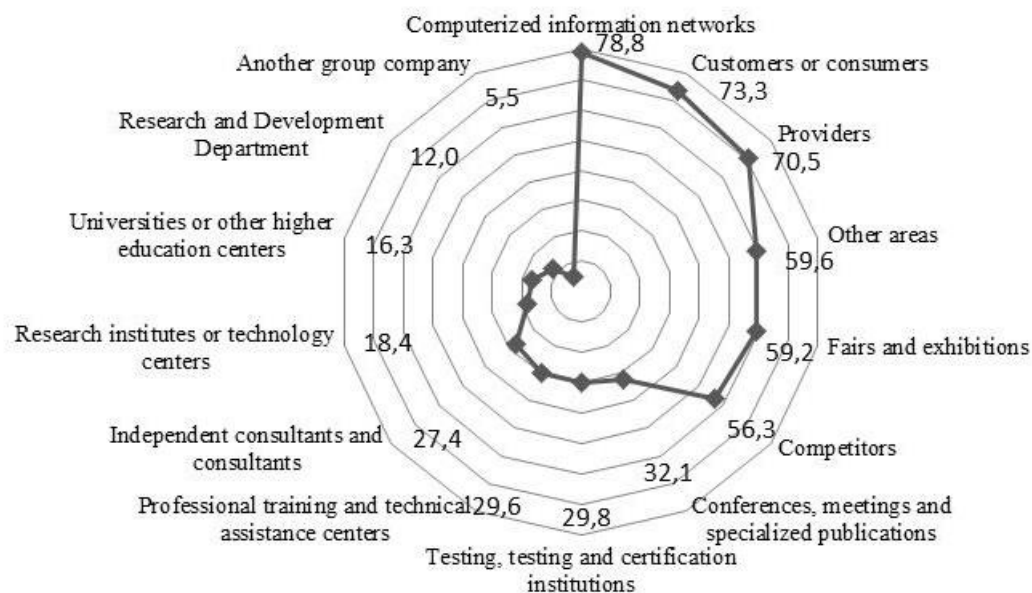


FIGURE 09 - Information sources for innovation, according to the percentage of manufacturing industries that implemented product or process innovations and that indicated a medium or high degree of importance (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

When analyzing the most important cooperation partnerships, Suppliers, Clients and consumers stood out,

and far more distant, testing, testing and certification institutions, with 76.1%, 70.5% and 33.9%, respectively, of industries pointing to high or medium importance (Figure 10).

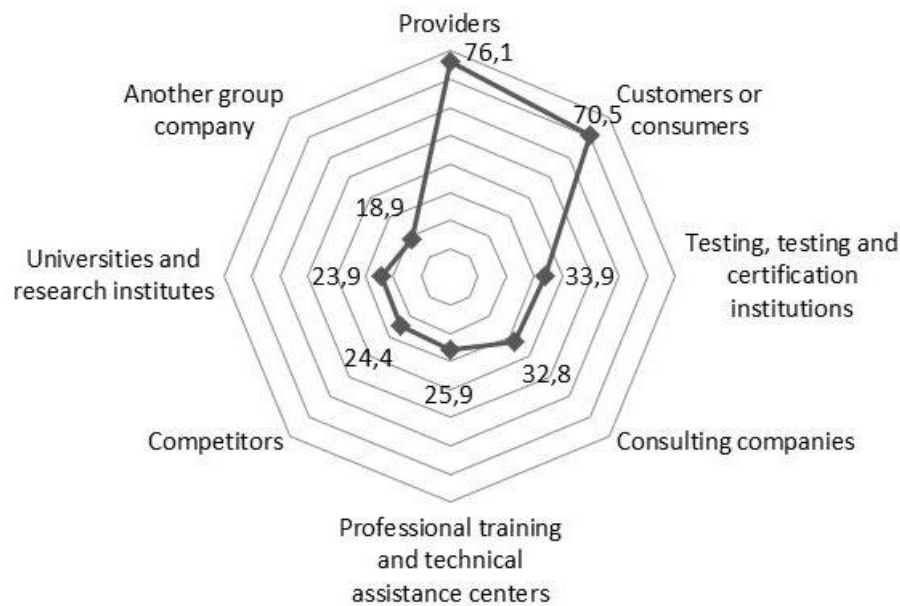


FIGURE 10 - Cooperation partners, according to the percentage of manufacturing industries that implemented product or process innovations and that indicated a medium or high degree of importance (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

The industries that implemented process or product innovations evaluated that the major impacts caused by this innovative behavior were: Maintenance of the company's market share (81.3%), Improvement of product quality (80.6%) and Increase of productive capacity (73.6%), having received high or medium importance (Figure 11).

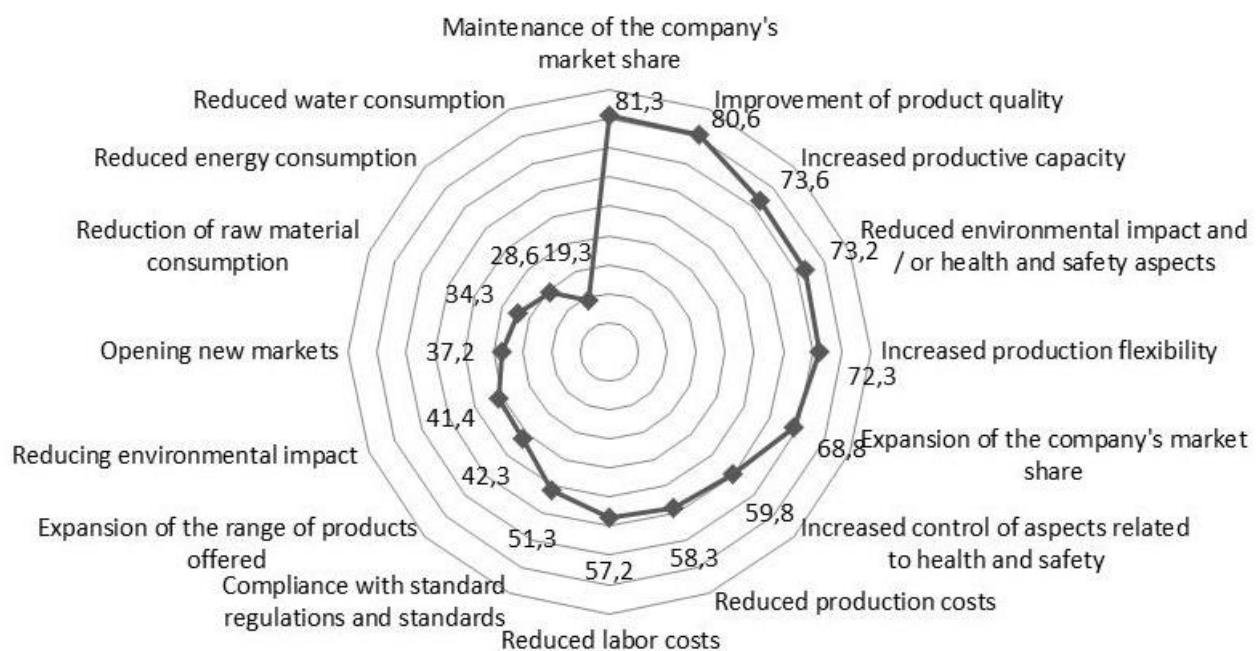


FIGURE 11 - Impacts of innovations, according to the percentage of manufacturing industries that

implemented product or process innovations and that indicated a degree of medium or high importance (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

Of the industries that implemented innovation, 31.2% used some government program to finance machinery and equipment to innovate and 7.7% used Other support programs (Figure 12).



FIGURE 12 - Percentage of innovative manufacturing industries that used government programs, by type of support (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

Among the industries that implemented product or process innovations, the main problems and obstacles to innovate were pointed out: the high costs of innovation (82.3%), the excessive economic risks (75.3%) and the scarcity of appropriate sources of financing (64.0%). See Figure 13.

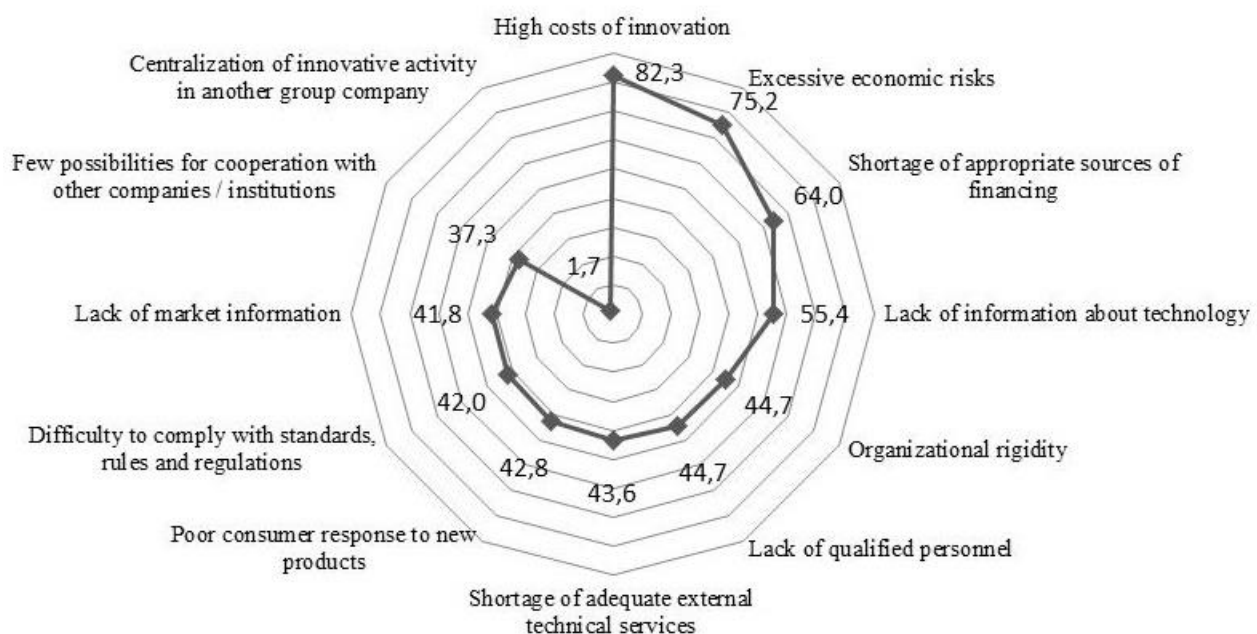


FIGURE 13 - Problems and obstacles to innovate, according to the percentage of manufacturing industries that implemented product or process innovations and that indicated medium or high importance (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

When asked about the reasons for not innovating, Brazilian transformation industries pointed out as the most important cause, with 56.3%, market conditions (Figure 14).

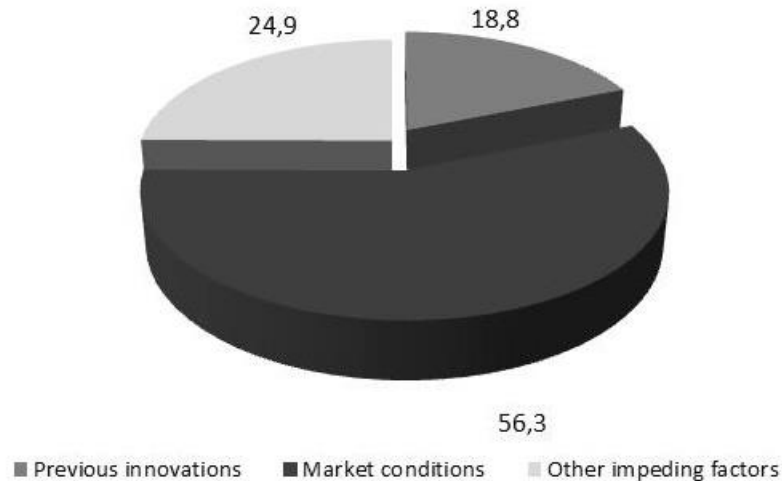


FIGURE 14 - Reasons given by the manufacturing industries for not innovating (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

In the industries that implemented product or process innovation and that also carried out organizational and marketing innovations, the main innovations in these areas, as can be seen in Figure 15, were Management techniques (60.7%), Work organization (57, 1%) and Aesthetics, design or other changes (50.2%).

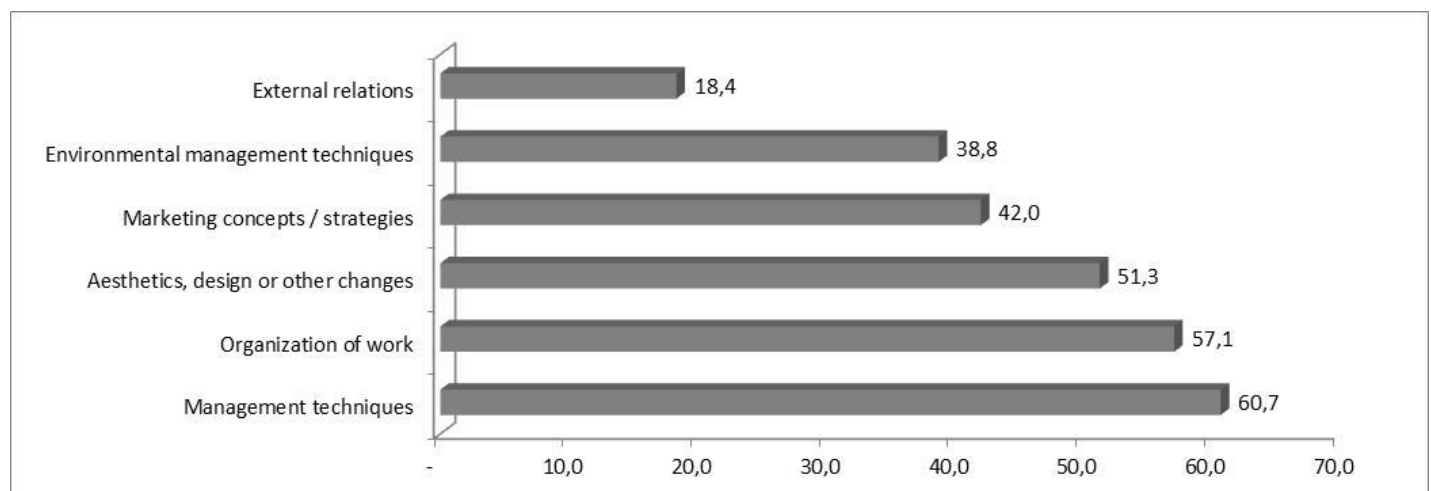


FIGURE 15 - Rate of manufacturing industries that implemented product or process innovations, and that carried out organizational and marketing innovations, by type of innovation (Brazil - 2012-2014).

Source: Adapted from IBGE - PINTEC / 2014.

Figure 16 shows that among the industries that did not implement product or process innovation, but that carried out organizational and marketing innovations, the main innovations in this area were also Management techniques (28.3%), Work organization (28.0 %) and Aesthetics, design or other changes (23.0%).

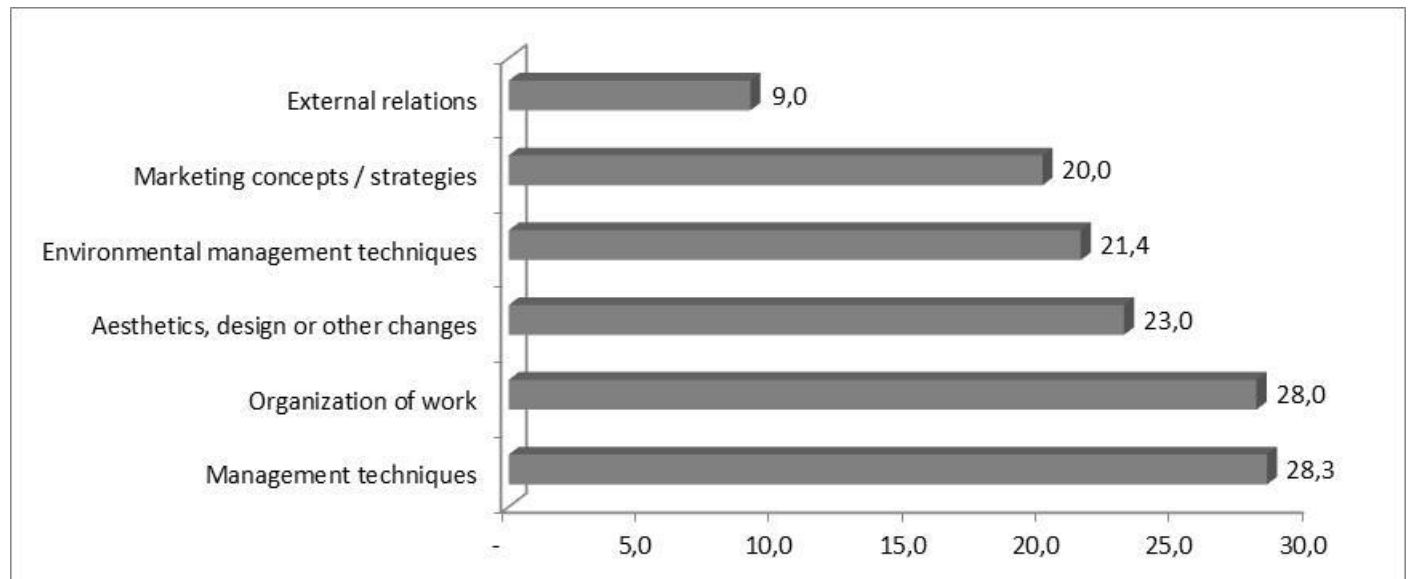


FIGURE 16 - Rate of non-innovative manufacturing industries in products or processes and without projects, which carried out organizational and marketing innovations - Brazil - 2012-2014.

Source: Adapted from IBGE - PINTEC / 2014.

To provide intellectual protection for innovations, in addition to legal protections (patent, utility model, etc.) it is also possible to use other types, considered more strategic depending on the type of innovation. When analyzing the responses on the use of these other types of protection (Figure 17), it was found that the most common is the Industrial Secret (11.1%), followed by the Leadership Time over competitors (6.5%) and Design Complexity (5.7%).

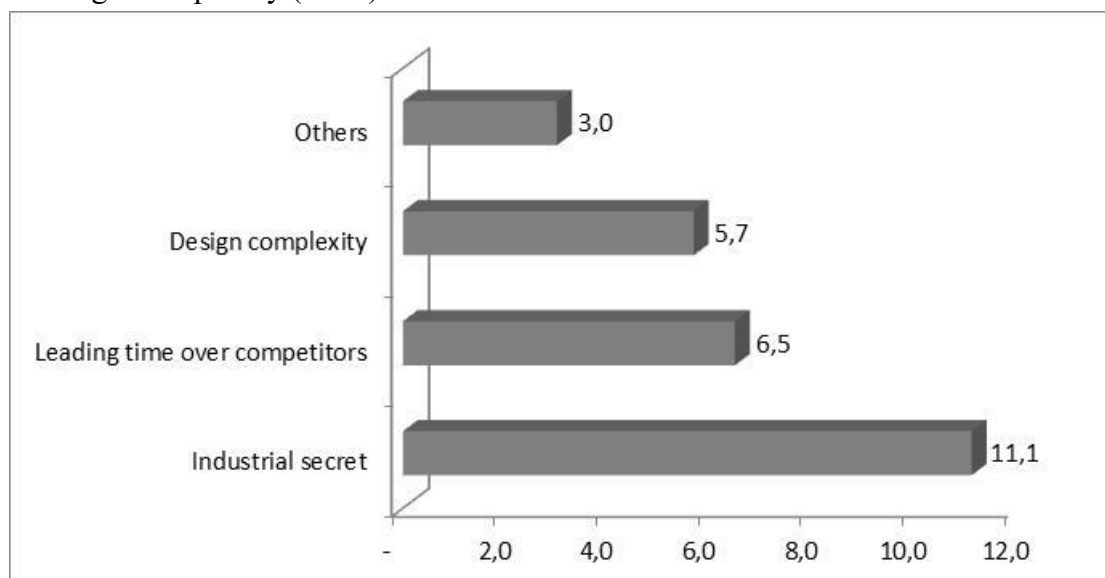


FIGURE 17 - Rate of manufacturing industries that used strategic, non-formal methods of protection in the total of those that implemented innovations - Brazil - 2012-2014 period.

Source: Adapted from IBGE - PINTEC / 2014.

4.2 The use of Industrial Property in Brazil

When analyzing the Brazilian innovative environment, as seen in the previous item, it appears that the industries still need to advance a lot, but the effort needs to be even greater when observing the data on the use of Industrial Property in Brazil.

The National Institute of Industrial Property (INPI) publishes on its website several data (in its area of statistical data and in its studies, bulletins and other publications), presenting information that allows to know in more detail the reality of the use of Industrial Property in Brazil.

According to the data made available by the INPI, in the year 2017, 25,658 Invention Patents (IP) were filed in the country, of which 5,480 came from residents of Brazil. 2,843 Utility Models and 81 Addition Certificates were also deposited by residents.

When analyzing the profile of resident depositors, of Patent of Invention, it appears that almost half (47%) are individuals, followed by educational and research institutions and government (23.9%). Only 26.7% of this type of deposit comes from companies, as can be seen in Figure 18.

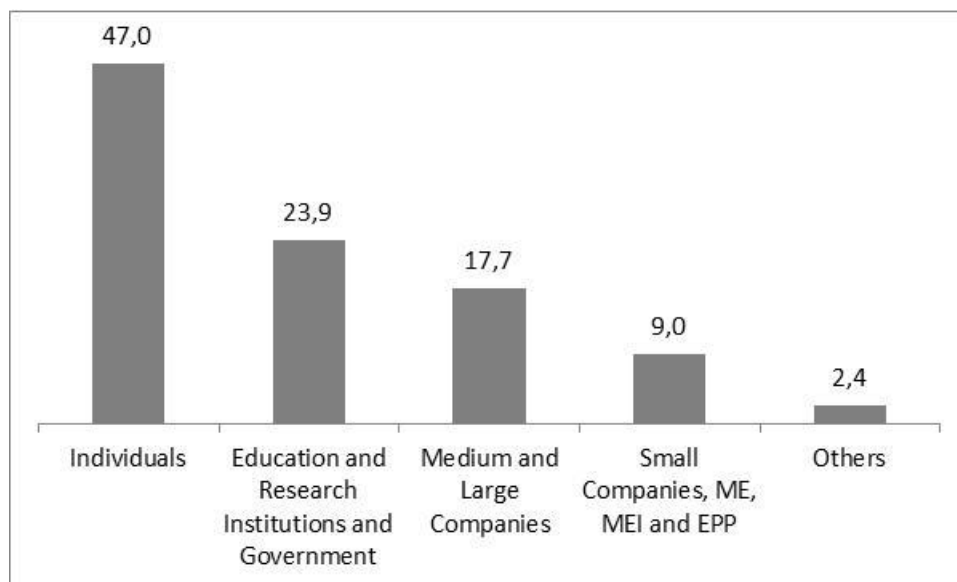


FIGURE 18 - Profile of Resident Depositors - Invention Patent - BR, 2017 (%).

Source: Adapted from INPI, 2018.

When analyzing Figure 19, it can be seen that between 2012 and 2017 there was a reduction in both the total deposit of Invention Patents (PI) and the Utility Model (MU), being 15.7%, in the first case, and 3.1% in the second.

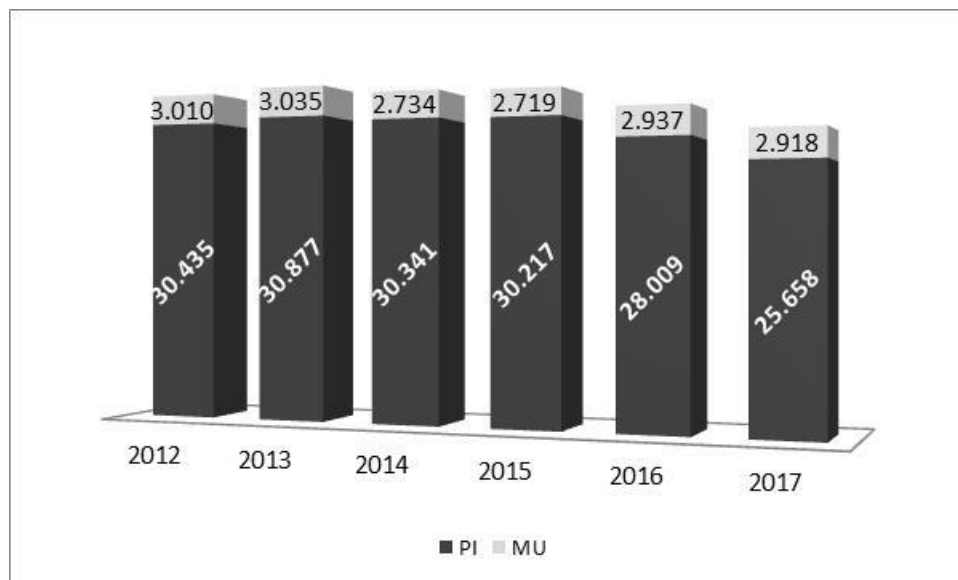


FIGURE 19 - Total deposit by type - BR 2012 to 2017.

Source: Adapted from INPI, 2018.

Differently from what happened with the total, Figure 20 shows that the deposits of Invention Patents made by residents grew more than 14%, between 2012 and 2017. It is also worth mentioning the significant participation of residents regarding the Utility Model (MU), which in 2017 represented over 97% of the total deposits of this type in Brazil.

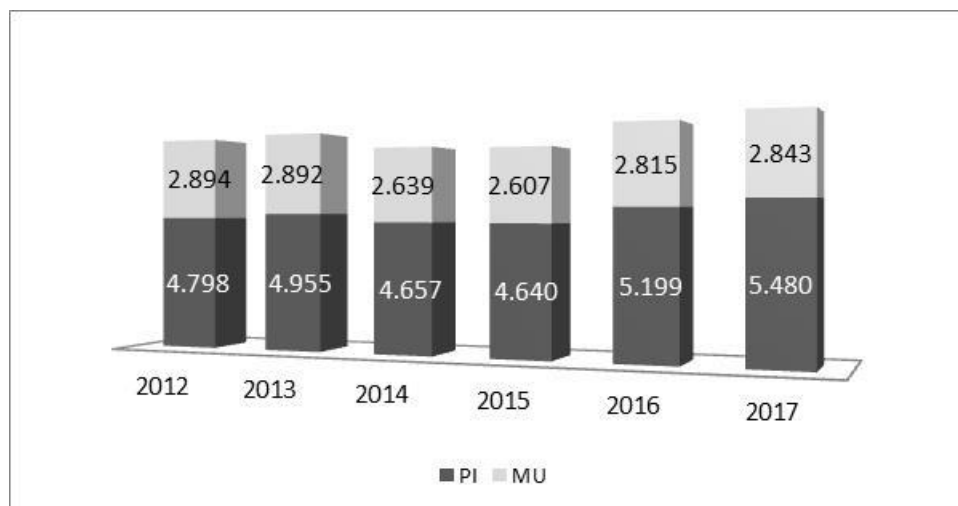


FIGURE 20 - Deposit of residents by type - BR 2012 to 2014.

Source: Adapted from INPI, 2018.

When analyzing the legal nature of patent depositors, Figure 21 reveals that there was an increase in the participation of the legal entity, both in invention patents and in utility models. Despite this growth, there is still a great disparity between the number of industries in the country (more than 364 thousand in 2017) and the amount of deposits made by companies.

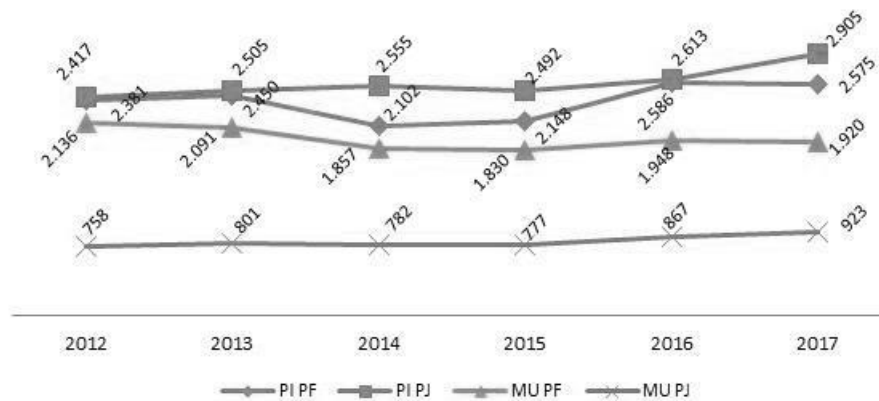


FIGURE 21 - Patent Deposits by Type and Legal Nature of the 1st Depositor, BR - 2012 to 2017.

Source: Adapted from INPI, 2018.

5. Final Discussions and Considerations

Innovation contributes decisively to the development of a society. In view of this finding, countries need to stimulate the innovative process of both Science and Technology Institutions (ICTs) and companies, which ultimately bridge the gap between the technologies produced and society.

Between the idea, behind an innovation, and its transformation into a product or service (new or improved), made available to consumers, there are several steps that will achieve much more efficient results if they are managed in a more structured way.

As all these steps have financial and economic costs involved, the possibility arises of seeking legal protection, through Industrial Property, to avoid the unfair entry of competitors who could simply misappropriate all the research and development already carried out, without need to make the investments already paid for by the innovative company.

Throughout the study, it was found that Brazil occupies the 64th position in the ranking of the countries that make up the Global Innovation Index (GII), being a very timid position, when taking into account the world importance of the Brazilian economy, which throughout in recent years it is among the 10 largest in the world.

To better understand the issues that generate this result, especially in terms of innovative business performance, this study analyzed the internal environment of Brazilian manufacturing industries, which represent more than 87% of the national industrial park, as well as their main innovative interactions with the external environment.

The industrial segment has great relevance in the generation of innovation, especially in technology. Despite this, in Brazil only approximately 36% of companies in this segment developed some innovative product or process action, between 2012 and 2014.

It is worth mentioning that the innovative action pointed out as the most relevant refers only to the updating of the industrial park (acquisition of machinery and equipment, acquisition of software and training of employees), being the first item also the most relevant from the point of view of financial investments. , relegating investments in R&D to the second place, in financial terms, and to the sixth place in relation to the importance attributed by the companies.

Despite the low percentage of companies that innovate in products and processes, a positive fact is that more than 72% of them carry out continuous R&D activities. It is also worth mentioning the fact that almost 61% of the people dedicated to this type of activity do so exclusively, being mostly researchers or technicians.

Research institutes or technological centers and universities or other higher education centers are considered as a source of information of high or medium importance for only 18.4% and 16.3%, respectively, of the manufacturing industries. This ends up being reflected in a small percentage of industries that consider the existence of cooperation partnerships with these institutions to be important. This fact reinforces the need to strengthen actions to bring together knowledge institutions and the business sector.

Relevant information, and that innovative companies recognize, is the importance of innovation for maintaining market share, which is followed by improving the quality of products and increasing productive capacity, based on innovative actions.

The costs of innovation are often significant and that is why governments in the most innovative countries develop robust programs for innovative stimulus. In Brazil less than 48% of the manufacturing industries used government programs to innovate and even so the vast majority used only to finance machinery and equipment, with very low use of government programs for R&D. This fact ends up being reflected in the main problems or obstacles pointed out, to innovate, which are the high costs of innovation, the excessive economic risks and the scarcity of appropriate sources of financing.

The low degree of innovation, mainly from investments in R&D, can be pointed out as one of the causes of the low use, by companies, of Intellectual Property, especially Industrial Property, which is an efficient way to protect part of the investments made for the development of new products, services or processes.

In Brazil, almost half of patent applications are made by individuals, while companies account for well below one third of the total. Even with a growth in the number of depositing companies, the representation is still small, when compared, in particular, with the number of transformation industries existing in Brazil.

Despite the short time, to generate practical effects in the context of strengthening the innovative environment, "Decree n° 9.283, of February 7, 2018" deserves mention, which established measures to encourage innovation and scientific and technological research in the productive environment, stimulating the acceleration of the development of the national and regional productive system.

All the questions analyzed during the study show that there is still a long way to go to strengthen the innovative environment of Brazilian industries. More robust actions, mainly focused on stimulating and financing R&D, may lead to an increase in the deposit of patents and the use of other intellectual protection instruments for new products, services and processes, contributing more significantly to accelerate the growth of participation of Brazil in the international innovation scenario.

7. References

Aleixo G. G. & Tenera, A. B. (2009). New Product Development Process on High Tech Innovation Life Cycle. *World Academy of Science, Engineering and Technology International Journal of Industrial and*

Manufacturing Engineering, Vol:3, No:10. Recuperado em 30 de outubro de 2018, de <http://waset.org/publications/8636>.

Almeida, M. L., Silva, J. L. G. & Oliveira, E. A. A. Q. (2014). A inovação como fator de desenvolvimento regional. *Revista Brasileira de Gestão e Desenvolvimento Regional*, v. 10, n. 3. Recuperado em 13 de junho de 2018, de <http://www.rbgdr.net/revista/index.php/rbgdr/article/view/1483>.

Bonazzi, Z. F., & Zilber, A. M. (2014). Inovação e Modelo de Negócio: um estudo de caso sobre a integração do Funil de Inovação e o Modelo Canvas. *RBGN Revista Brasileira de Gestão de Negócios*, 16(53), 616-637. doi:<https://doi.org/10.7819/rbgn.v16i53.1812>

Dosi, G. (1988). The nature of the innovative process. In: G. Dosi (org.), *Technical change and economic theory*. Londres, Pinter Publishers, pp. 221-38.

Esteves, G. & Nohara, J. J. (2011). Fatores críticos à estabilidade das alianças estratégicas das micro e pequenas empresas. *RAI - Revista de Administração e Inovação*, São Paulo, v. 8, n. 3, p. 182-204, nov. Recuperado em 13 de junho de 2018, de <http://www.revistas.usp.br/rai/article/view/79232>.

Faria, N. & Sofia, L. (2012). I9 – Novo modelo de gestão de inovação em uma empresa de serviço de entretenimento”, *Sistemas & Gestão*, 7(2), pp.274-286. Recuperado em 13 de junho de 2018, de <http://www.revistasg.uff.br/index.php/sg/article/viewFile/V7N2A10/V7N2A10>.

Flynn, M. Dooley, L., O'sullivan, D. & Cormican, K. (2003). Idea management for organizational Innovation. *International Journal of Innovation Management*. 7 (4):417-442. <http://dx.doi.org/10.1142/S1363919603000878>.

IBGE, Instituto Brasileiro de Geografia e Estatística. Pesquisa de inovação - PINTEC: 2014. Tabelas Completas. Recuperado em 30 de junho de 2018, de https://ww2.ibge.gov.br/home/estatistica/economia/industria/pintec/2014/default_xls.shtm.

IEL, Instituto Euvaldo Lodi Núcleo Central. (2010). A caminho da inovação: proteção e negócios com bens de propriedade intelectual: guia para o empresário. Brasília. Recuperado em 30 de junho de 2018, de: http://www.inpi.gov.br/sobre/arquivos/guia_empresa_iel-senai-e-inpi.pdf.

INPI, Instituto Nacional de Propriedade Industrial. Estatísticas. Recuperado em 20 de setembro de 2018, de <http://www.inpi.gov.br/sobre/estatisticas/estatisticas>.

"Jiménez-Jiménez, D. e Sanz-Valle, R. (2011). Innovation, organizational learning, and performance, *Journal of Business Research*, Volume 64, Issue 4, 2011, Pages 408-417. <https://doi.org/10.1016/j.jbusres.2010.09.010>.

Kenski, V. W. & Marcondes, Reynaldo Cavalheiro. (2017). O Programa Inovativo da Pequena Empresa (PIPE) da FAPESP como indutor do desenvolvimento de micro e pequenas empresas de base tecnológica. *Gestão & Produção*, 24(4), 667-679. Epub 04 de setembro de 2017. <https://dx.doi.org/10.1590/0104-530x1256-16>

Kock, A., Heising, W. E. & Gemuenden, H. G. (2015). How ideation portfolio management influences front-end success. *Journal of Product Innovation Management*, Darmstadt, v. 32, n. 4, p. 539 -555, July. <http://dx.doi.org/10.1111/jpim.12217>.

Maçaneiro, M. & Cherobim, A. (2011). Fontes de financiamento à inovação: incentivos e óbices às micro e pequenas empresas – estudo de casos múltiplos no estado do Paraná. *O&S*, Salvador, v.18 - n.56, p. 57-75. Recuperado em 20 de setembro de 2018, de <https://portalseer.ufba.br/index>.

php/revistaoes/article/view/11138/8050.

Mattos, J. F. C., Stoffel, H. R. & Teixeira, R. A. (2010). Mobilização empresarial pela inovação: cartilha – gestão da inovação. Brasília: CNI. Recuperado em 22 de agosto de 2018, de https://static-cms-si.s3.amazonaws.com/media/filer_public/9d/16/9d16abac-a115-4758-b4dc-9a3e3d21a8d0/20121126110821586027u.pdf.

Mello, J, Martins, W. L. S, Vaz, C. R., Francisco, A. C. & Selig, P. M. (2013). Gestão da inovação em organizações: um estudo de caso em uma empresa de pequeno porte no segmento metalúrgico na cidade de Curitiba – PR. *Revista Holos*, ano 29, vol 13. <https://doi.org/10.15628/holos.2013.1350>.

Mendes, L. M. & Borher, B. A. (2012). O ensino da propriedade intelectual: mapeando as academias da rede global. *Revista Brasileira de Inovação*, v. 11, n. 2, p. 399-432. Recuperado em 22 de janeiro de 2018 de <https://periodicos.sbu.unicamp.br/ojs/index.php/rbi/article/view/8649049/15598>.

OCDE. (2006). Manual de Oslo: diretrizes para a coleta e interpretação de dados sobre inovação tecnológica. Publicado pela FINEP (Financiadora de Estudos e Projetos), 3ª Edição, 2006. Recuperado em 27 de fevereiro de 2018 de <http://www.finep.gov.br/images/apoio-e-financiamento/manualoslo.pdf>.

Ortt, R. J. & Duin, P. A. (2008). The evolution of innovation management towards contextual innovation. *European Journal of Innovation Management*, Vol. 11 Issue: 4, pp.522-538. <https://doi.org/10.1108/14601060810911147>.

Ramos, M. A. W. , Figueiredo, P. S., & Pereira-Guizzo, C. (2018). Antecedents of innovation in industry: The impact of work environment factors on creative performance. *Innovation & Management Review*, Vol. 15 Issue: 3, pp.269-285. <https://doi.org/10.1108/INMR-05-2018-0032>.

Rita, L. P. S., Araujo, A. C., Paula, M. A., Lima, M. O. & Viana Filho, J. C. (2010). Consumo de produtos e serviços inovadores: aplicação do índice de prontidão para tecnologia. *Revista Brasileira de Inovação*, v. 9, n. 1, p. 167-196. Recuperado em 27 de fevereiro de 2018 de https://www.researchgate.net/publication/47697240_Consumo_de_produtos_e_servicos_inovadores_aplicacao_do_indice_de_prontidao_para_tecnologia.

Schumpeter, Joseph Alois. (1982). Teoria do desenvolvimento econômico: uma investigação sobre lucros, capital, crédito, juro e o ciclo econômico. São Paulo: Abril Cultural.

Silva, G; Dacorso, A. L. R. (2013). Inovação aberta como uma vantagem competitiva para a micro e pequena empresa. *RAI - Revista de Administração e Inovação*, São Paulo, v. 10, n. 3, p. 251-268, oct. Recuperado em 27 de fevereiro de 2018 de <http://www.revistas.usp.br/rai/article/view/79337>.

Souto, J. E. (2015). Business model innovation and business concept innovation as the context of incremental innovation and radical innovation. *Tourism Management*. Elsevier. December. <https://doi.org/10.1016/j.tourman.2015.05.017>.

Universidade Cornell, Insead & WIPO. (2017). Índice Global de Inovação de 2017: A Inovação Nutrindo o Mundo. Ithaca, Fontainebleau e Genebra. Recuperado em 27 de junho de 2018 de <http://www.portaldaindustria.com.br/publicacoes/2017/11/indice-global-de-inovacao-de-2017-inovacao-nutrindo-o-mundo>.

Universidade Cornell, Insead & WIPO. (2018). The Global Innovation Index 2018: Energizing the World with Innovation. Ithaca, Fontainebleau e Genebra. Recuperado em 27 de outubro de 2018 de http://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2018.pdf

Vargas, C., Gruber, V., Esteves, P., & Silva, S. (2016). Gestão da Inovação Empresarial. *Tecnologias da Informação e Comunicação: Pesquisa e Inovação*, 159-175. Recuperado de <https://publicacoes.rexlab.ufsc.br/index.php/ticpesquisaeinovacao/article/view/57>

WIPO, World Intellectual Property Organization. What is Intellectual Property? Recuperado em 27 de junho de 2018 de <http://www.wipo.int/portal/en/index.html>.

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/>).

Application of indexes to evaluate the water quality of the Continguiba/Pindoba Irrigated Perimeter in Sergipe, Brazil

Amanda Oliveira Souza

Mestre em Recursos Hídricos, Universidade Federal de Sergipe,
São Cristovão, Sergipe, Brasil.

Clayton Moura de Carvalho

Doutor em Engenharia Agrícola, Professor do Instituto Federal de Educação, Ciência e Tecnologia Baiano,
Serrinha, Bahia, Brasil.

Raimundo Rodrigues Gomes Filho (Corresponding author)

Doutor em Engenharia Agrícola, Professor do Departamento de Engenharia Agrícola da
Universidade Federal de Sergipe, São Cristovão, Sergipe, Brasil. E-mail: rrgomesfilho@hotmail.com

Carlos Alexandre Borges Garcia

Doutor em Ciências, Professor do Departamento de Química da Universidade Federal de Sergipe,
São Cristovão, Sergipe, Brasil.

Elder Sanzio Aguiar Cerqueira

Doutor em Engenharia Agrícola, Professor do Departamento de Transporte e Geodésia, Engenharia
de Agrimensura e Cartográfica, Salvador, Bahia, Brasil.

Manoel Valnir Júnior

Doutor em Engenharia Agrícola, Instituto Federal de Educação, Ciência e Tecnologia do Ceará,
Sobral, Ceará, Brasil.

Leonaria Luna Silva de Carvalho

Mestre em Engenharia Agrícola, Universidade Federal do Ceará,
Fortaleza, Ceará, Brasil.

Renisson Neponuceno Araújo Filho

Doutor em Agronomia, Professor do Departamento de Engenharia Florestal da Universidade Federal
de Tocantins, Gurupi, Tocantins, Brasil.

Victor Casimiro Piscoya

Doutor em Ciências do Solo, Professor da Universidade Federal Rural de Pernambuco, Recife,
Pernambuco, Brasil.

Moacyr Cunha Filho

Doutor em Ciências do Solo, Professor do Departamento de Estatística e Informática da Universidade Federal Rural de Pernambuco, Recife, Pernambuco, Brasil.

Abstract

Irrigation makes food production viable, but the quality and quantity of water may be compromised as a result of inadequate management, which may lead to an increase in the concentration of nutrients, heavy metals and agrochemicals. This study aimed to characterize and monitor the water quality of the Continguiaba/Pindoba Irrigated Perimeter in Sergipe, Brazil. Secondary data from the Water Quality Monitoring Program were used through the reports of monitoring campaigns carried out between 2013 and 2014. The Water Quality Index (WQI) and the Trophic State Index (TSI) were used in the water quality assessment. The results showed that there is an influence of seasonality, where the best indices were obtained in the rainy season, with the WQI characterized as regular to good, and the TSI characterized as oligotrophic. There was interference from the drainage of rice lots in the dry season, contributing to the increase of nutrients. There was no spatial influence for WQI, which may be related to the eclipse effect, which attenuated the negative impact of a certain variable given the aggregation of several variables. The TSI suffered spatial influence, the waters added to agricultural and fish lots were classified as oligotrophic or ultraoligotrophic, already in the drainage were found indexes of super-utrophic state.

Keywords: Water resources; irrigated areas; climatic seasonality; anthropic action.

1. Introduction

Water is society's most important natural resource, which is indispensable for its survival (Barros et al. 2011). Water is essential for the survival of all species on the planet and is also the natural resource that faces most problems in terms of quality and quantity (Batista et al. 2014). Water quality reflects the effects of the various processes that have occurred along the way, as well as the influence of the characteristics of the watershed (Massoud 2012).

Changes in water quality can be determined by its physical, chemical and biological characteristics, with a view to characterizing this resource in relation to its different uses and identifying the causes of possible degradation of water resources (Santos et al. 2011).

When the forest is removed giving way to agricultural production systems, or pastures, not only the landscape is altered, but also the water quality of the watershed. Multiple uses and activities in a watershed cause relevant changes in the quality of water resources (Andrietti et al. 2016).

Several countries in the world have faced accelerated eutrophication and degradation of aquatic environments caused mainly by human interference (Bucci and Oliveira 2014).

As a result, the use of water quality indices is a way to monitor surface waters, predict and monitor, through diminished information, the possible deterioration of water resources along the watershed or over time (Blume et al. 2010; Barros et al. 2014).

The use of water quality indicators is of extreme importance for strategy in environmental monitoring and management programs, as it allows for a large amount of information to be converted into an easy to understand concept (Costa et al. 2012). Several researchers have conducted water quality monitoring studies in recent years (Pontes et al. 2012; Veríssimo and Ferreira 2013; Bucci and Oliveira 2014; Santos et al. 2018; Carvalho et al. 2019; Carvalho et al. 2020).

When assessing the quality of surface water, it is necessary to employ methods that are easy to understand so that the information can be transmitted to the users of water resources (Ferreira et al., 2015). The water quality index gives relevance to pollution from domestic sewage, which is the main source of pollution in watershed (Alves et al. 2012). The Trophic State Index aims to classify water bodies in different degrees of degradation by surveying concentrations of the limiting nutrient and chlorophyll "a" (Cordeiro et al. 2009).

In view of this, the objective was to investigate the quality of surface waters in the irrigated Cotinguiba/Pindoba perimeter, in the State of Sergipe, Brazil, using the Water Quality Index - WQI and the Trophic State Index - TSI.

2. Material and Methods

2.1 Characterization of the Study Area

The study area corresponded to the Irrigated Perimeter formed by the junction of two villages Cotinguiba and Pindoba, located between geographical coordinates UTM 24L 8868577 m and 8860105 m south latitude and between UTM 24L 740720 m and 750810 m west longitude, with an altitude of approximately 10 m, Figure 1.

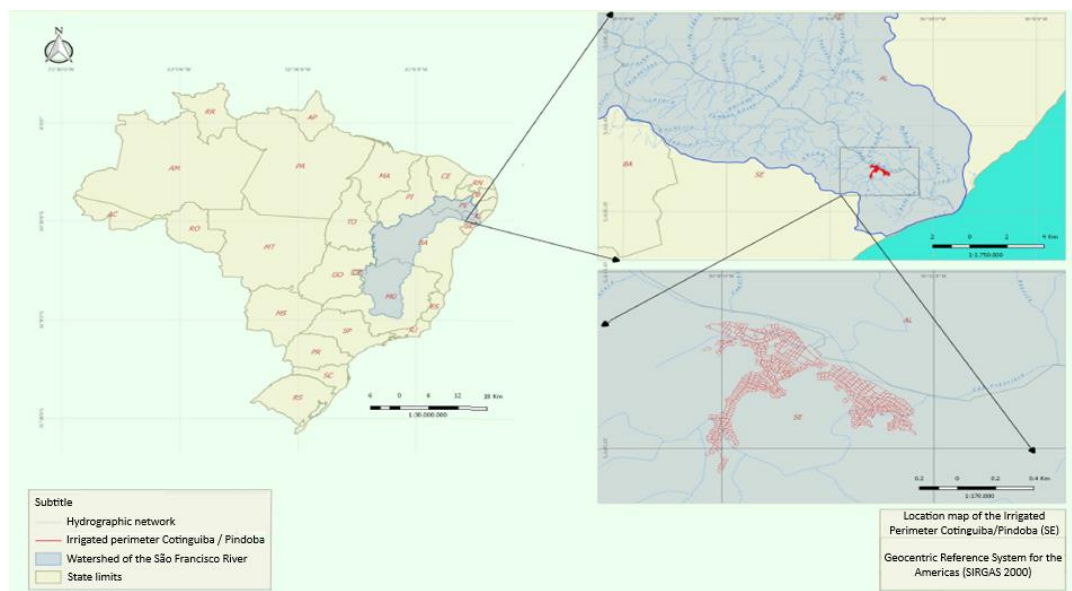


Figure 1. Location Map of the Irrigated Perimeter of Cotinguiba/Pindoba, Sergipe, Brazil.

According to the guidelines of the Land Use Classification System - SCUT, the area under study is characterized by the predominance of more than 90% of Anthropic Agricultural Areas and the second

most representative class is water. In this anthropic agricultural area there are important irrigated perimeters that have diversified crops, both temporary and permanent, in a consortium system or single crops, in addition to areas intended for fish farming (IBGE, 2011).

The Cotinguiba/Pindoba Irrigated Perimeter is located on the right bank of the San Francisco River, covering land in the municipalities of Japoatã, Neópolis and Propriá in the State of Sergipe. The perimeter is 112 km from the Sergipe capital, Aracaju, and the SE-200 highway is the main access road that connects the BR-101 to the SE-304 highway.

The Irrigation Project has a total area of 2,215 hectares, 474 agricultural plots, in which 85.9% of the areas are composed of family plots, and 13.2% of business plots (CODEVASF, 2014). The main activities developed are rice growing, polyculture, carciniculture and fish farming. The main crops are rice, green corn, banana and green coconut. Conventional sprinkler and flood irrigation systems are used. As a source of irrigation, the San Francisco River is the main contributor. The streams Pilões, Nossa Senhora, Estiva and Mussuipe also make up the hydrology of the perimeter.

The climate is of the semi-humid type, with rainfall predominating in autumn and winter. The average annual precipitation in the perimeter area is 851 mm, with an annual absolute maximum of 1,074 mm in 1914 and a minimum of 527 mm in 1946 (CODEVASF, 2005). The rains usually occur from March to September, with greater rainfall in the months of April to July, with May being the rainiest month. The dry season occurs from October to February. The average annual temperature is 25.2°C.

2.2 Data source

This research used secondary data, in the public domain, from the Water Quality Monitoring Program, through the reports of the monitoring campaigns carried out between 2006 and 2014, at the Cotinguiba/Pindoba Irrigated Perimeter. The sampling points can be seen in Figure 2.

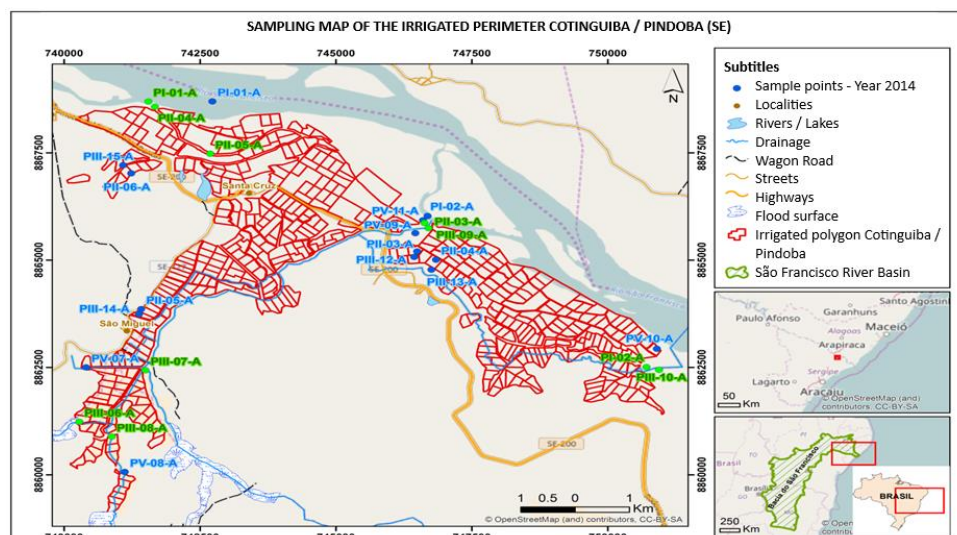


Figure 2. Water quality sampling points at the Cotinguiba/Pindoba Irrigation Perimeter, Sergipe, Brazil.

The monitoring program was intended to characterize the aquatic environment through physical, chemical and biological analysis of water and sediment samples, collected in rainy and dry periods between July 30 and August 7, 2013 and January 4 to 10, 2014 (CODEVASF, 2014).

Samples were collected at 15 (fifteen) distinct sampling stations in 2014 (Table 1), including sampling points in agricultural and fish farming lot drainage. In these stations 41 (forty-one) parameters were analyzed.

Table 1. Description of the sample stations of the surface water quality monitoring network of the Cotinguiba/Pindoba Irrigated Perimeter for the years 2013 and 2014 (CODEVASF, 2014)

Environment	Sample Station	Description	Main feature	Geographic Coordinates 24L UTM (m)	
Primary Source I	PI-01-A	On the riverbed of the San Francisco at least 100 meters upstream of the Pumping Station EB 1204	Water supply to irrigation project	742728	8868696
	PI-02-A	On the riverbed of the San Francisco at least 100 meters upstream of the Pumping Station EB 1204, mixing zone	Water supply to irrigation project	746685	8866026
Multipurpose II	PII-03-A	In the water sluice of lot 394	Water supply for fish farming lot	746494	8865200
	PII-04-A	In the water sluice of lot 400	Water supply for fish farming lot	746839	8865008
	PII-05-A	In the water sluice of lot 337	Water supply for agricultural lot	741415	8863856
	PII-06-A	In the water sluice of lot 495	Water supply for agricultural lot	741233	8867020
Perimeter/collector drainage	PV-07-A	At the entrance of the Estiva creek in the perimeter - lot 357	Drainage of agricultural lot - rice growing	740406	8862502
	PV-08-A	At the entrance of the Pilões creek in the perimeter - lot 389	Drainage of agricultural lot - rice growing	741116	8860068
	PV-09-A	At the entrance of the Mussuïpe creek in the perimeter - lot 237	Drainage of agricultural lot - rice growing	746459	8865626
	PV-10-A	In the drainage of the Pumping Station EB 1102 – EBD 01	Perimeter drainage	750903	8862934
	PV-11-A	In the drainage of the Pumping Station EB 1602 – EBD 02	Perimeter drainage	746599	8865926
Drainage of agricultural lot and/or fish farming	PIII-12-A	In the water sluice of lot 394	Drainage of fish farming lot	746438	8865072
	PIII-13-A	In the water sluice of lot 400	Drainage of fish farming lot	746755	8864776
	PIII-14-A	In the water sluice of lot 337	Drainage of agricultural lot	741376	8863740

Environment	Sample Station	Description	Main feature	Geographic Coordinates 24L UTM (m)	
			lot - rice growing		
	PIII-15-A	In the water sluice of lot 495	Drainage of agricultural	741084	8867208
			lot - rice growing		

2.3 Preliminary evaluation of input data

The preliminary evaluation consisted of organizing and systematizing the database in order to make possible its use in statistical analysis and water quality assessment indices. The secondary data were organized in Excel spreadsheets, for each Sample Station, considering the year of implementation of the monitoring station.

Considering the different rainfall in the sampling months, this study addressed a discussion of seasonal influence, considering a period of drought, with lower rainfall in January 2014 and a rainy period in August 2013.

For spatial analysis of the influence of the irrigation project on water quality in the region under study, monitoring stations were divided by their location, seeking to divide those that do not suffer the interference of the irrigation project, upstream, also called entry stations and the exit stations that are downstream of the project and that have as a basic characteristic the proximity to drainage zones of rice and fish production lots.

2.4 Water Quality Index (WQI)

The variables temperature, hydrogen ion potential (pH), biochemical oxygen demand (BOD), total nitrogen, dissolved oxygen, total solids, total phosphorus, turbidity and thermotolerant coliforms were used for the application of the Water Quality Index (WQI). From the calculation, the value was assigned to the surface water quality, indicated by the WQI on a scale from 0 to 100.

The WQI incorporates nine parameters considered relevant for the assessment of water quality for public supply. The index is calculated by the weighted producer of the water quality corresponding to the variables that make up the index, according to Equation 1.

$$WQI = \prod_{i=1}^n q_i^{w_i} \quad (1)$$

wherein:

WQI = Water Quality Index, scale from 0 to 100;

q_i = quality of parameter i , obtained on the basis of the specific average curve of quality;

w_i = weight attributed to the parameter, according to its importance in quality, between 0 and 1.

The weights of the parameters (w) were attributed considering the importance of the global conformation of water quality, with dissolved oxygen being the variable with the highest weight attributed (0.17) and total solids the one with the lowest weight (0.08). The WQI values were analyzed using classification intervals (Table 2), for which quality levels were defined, and CETESB (2005) also assigns reference colors.

Table 2. Water Quality index (WQI) ranges with respective quality levels and reference colors

WQI ranges	Quality levels	Reference colors
$79 < \text{WQI} \leq 100$	Great	Blue
$51 < \text{WQI} \leq 79$	Good	Green
$36 < \text{WQI} \leq 51$	Regular	Yellow
$19 < \text{WQI} \leq 36$	Bad	Red
$\text{WQI} \leq 19$	Terrible	Purple

The quality indexes were calculated using some variables, but for 2006 it was not possible to evaluate the WQI because in none of the stations were analyzed together the nine necessary parameters: water temperature, pH, dissolved oxygen, biochemical oxygen demand, fecal coliforms, total nitrogen, total phosphorus, total solid and turbidity.

2.5 Trophic State Index (TSI)

The Trophic State Index (TSI) was calculated from the values of phosphorus and chlorophyll-a using the Lamparelli methodology (2004). The TSI, which uses the identified phosphorus concentrations in the water body, could not be verified in 2006, since no phosphorus concentrations were identified in the analyses. Therefore, discussions regarding the WQI and TSI indexes were based on the monitoring campaigns of August 2013 and January 2014.

Equation 2 expresses the TSI calculation for rivers, where total phosphorus (TP) is expressed in $\mu\text{g L}^{-1}$. Equation 3 expresses the calculation of the TSI for rivers, where chlorophyll-a (CL) is expressed in $\mu\text{g L}^{-1}$. Discussions on this index were based on the arithmetic mean of the TSI to TP and TSI to CL, which was assigned the term MTSI.

$$TSI_{TP} = 10 \times \left(6 - (0.42 - 0.36 \times \left(\frac{\ln(TP)}{\ln(2)} \right)) \right) - 20 \quad (2)$$

$$TSI_{CL} = 10 \times \left(6 - (0.7 - 0.6 \times \left(\frac{\ln(CL)}{\ln(2)} \right)) \right) - 20 \quad (3)$$

The TSI values were obtained through the equations, the classes assigned to each of them and their characteristics (Table 3).

Table 3. Values, classes and characteristics of trophic states

TSI value	Trophic State Classes	Characteristics
$\text{TSI} < 47$	Ultra-oligotrophic	Clean water bodies, with very low productivity and insignificant concentrations of nutrients that do not cause damage to water uses.
$47 < \text{TSI} \leq 52$	Oligotrophic	Clean, low-productivity water bodies in which there is no undesirable interference with water uses due to the presence of nutrients.

52 < TSI ≤ 59	Mesotrophic	Water bodies with intermediate productivity, with possible implications for water quality, but at acceptable levels in most cases.
59 < TSI ≤ 63	Eutrophic	Water bodies with high productivity in relation to natural conditions, with reduced transparency, generally affected by anthropic activities, in which undesirable changes in water quality occur due to increased concentration of nutrients and interference in their multiple uses.
63 < TSI ≤ 67	Supereutrophic	Water bodies with high productivity in relation to natural conditions, low transparency, generally affected by anthropic activities, in which undesirable changes in water quality frequently occur, such as the occurrence of algae blooms, and interference in their multiple uses
TSI > 67	Hypereutrophic	Water bodies significantly affected by high concentrations of organic matter and nutrients, with marked impairment in their uses, associated with episodes of algae blooms or fish deaths, with undesirable consequences for their multiple uses, including on livestock activities in riverside regions.

Source: Adapted from Lamparelli (2004).

3. Results and Discussion

3.1 Application of the Water Quality Index - WQI

The boxplot of the Water Quality Index was observed in Figure 3, where in the dry period, the index varied from 31.79 to 80.25, classified as bad to good, while in the rainy period it varied from 64.40 to 85.87, classified as regular to good. Considering the seasonal variation it was found that the average WQI for the dry season was regular and in the rainy season it was good.

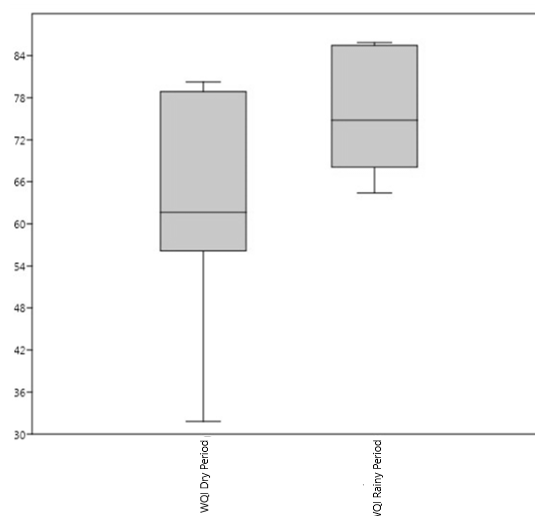


Figure 3. Time variation of WQI at Cotinguiba/Pindoba Irrigated Perimeter.

Barros and Souza (2013) obtained worse results for the Andre stream in Mirassol D'Oeste - MT, because in the dry season the WQI ranged from 37.0 to 56.0 and in the rainy season from 33.78 to 58.27, classifying the water quality as regular in both periods, the authors attributed this level to the disposal of domestic, commercial and agricultural effluents in the stream.

The water quality of the Irrigated Perimeter of Cotinguiba/Pindoba, according to the WQI values, was classified as regular quality, 69.42. Of the fourteen observations, six were regular, seven good and one bad.

Buzelli and Cunha-Santino (2013), when diagnosing the water quality of the Barra Bonita reservoir, SP, classified the water quality of the reservoir as good, for the period from 2007 to 2012, despite the intense anthropic pressures, mainly due to agricultural activities.

Santos et al. (2018) pointed out that the sources of anthropic contamination are still incipient and will probably contribute in the long run to the process of degradation and eutrophication of water bodies in the Sapucaia Coastal watershed in Sergipe, which currently have good quality water and WQI generally classified as good.

The spatial and seasonal variation of WQI can be seen in Figure 4. Only the PI-02-A Station had the index classified as bad during the dry season. This sampling point is located in the San Francisco River bed at least 100 meters upstream of the Pumping Station, it was expected that because it was not influenced by the Irrigation Project the index would not be classified this way.

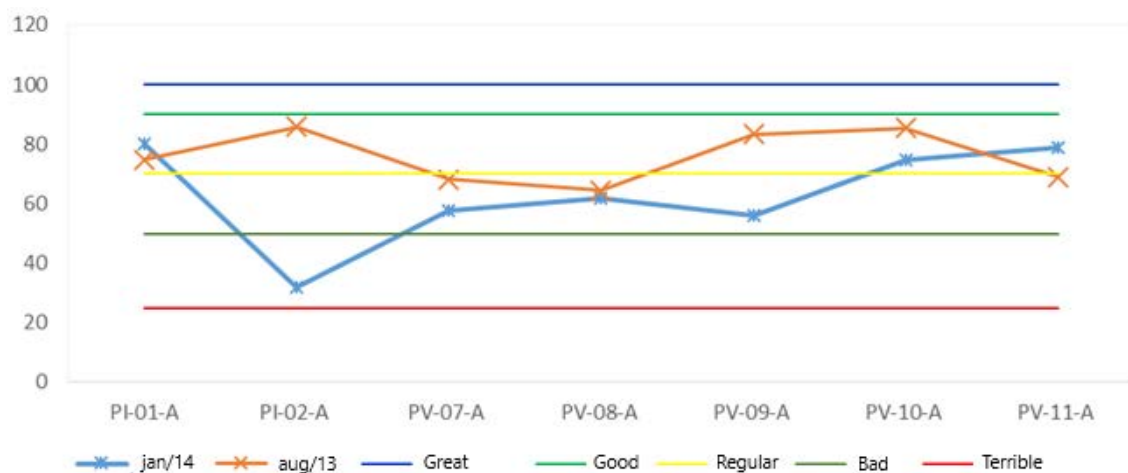


Figure 4. Seasonal and temporal variation of WQI.

Zanini et al. (2010) inferred that the anthropic activities along the banks of the Rico Stream, in Jaboticabal, SP, reduced the quality of its water during the different periods of the year, showing better quality in the rainy season and lower in the dry season.

In this study, the best rates were obtained in the rainy season, in PI-02-A, PV-09-A, PV-10-A and PV-11-A Stations (Table 4) being the first two of water supply to the lots and the last two of the water drained from the lots. Although the index remains in the same classification does not mean that there was no change in water quality, such classification may be related to the eclipse effect, classic and undesirable in water quality indexes, by aggregating several environmental variables in a single number, which may produce an

attenuation of the negative impact of one of the variables against the stable behavior of the others (Silva and Jardim 2006; Verrissimo and Ferreira 2013).

Table 4. Description of the sampling stations with their respective WQI for the dry and rainy periods

Stations	WQI Dry Period	Quality level	WQI Rainy period	Quality level	Characteristic and location of the sampling station
PI-01-A	80.2583	Good	74.7944	Good	Surface Water-Primary Source I-PI-01-A - In the bed of the San Francisco River by the 100 meters the upstream
PI-02-A	31.7983	Bad	85.8715	Good	Surface Water-Primary Source I-PI-02-A - In the bed of the San Francisco River by the 100 meters the upstream da EB01
PV-07-A	57.6643	Regular	68.0815	Regular	Perimeter Drainage/Collector V - At the entrance of the Estiva stream - In Lot 357 - rice growing
PV-08-A	61.6477	Regular	64.4040	Regular	Perimeter Drainage/Collector V - At the entrance of the Pilões stream - In Lot 389 - rice growing
PV-09-A	56.1331	Regular	83.3416	Good	Perimeter Drainage/Collector V - At the entrance of the Mussuípe stream - In Lot 237 - rice growing
PV-10-A	74.7053	Good	85.4674	Good	Perimeter Drainage/Collector V - In Pumping Station Drainage 1102 EBD 01
PV-11-A	78.8751	Good	68.9662	Regular	Perimeter Drainage/Collector V - In Pumping Station Drainage 1602 EBD 02

Simões et al. (2007), when evaluating the WQI in the Assis-SP region, with intense fish farming activity, obtained an indication of good quality, even with the significant change in alkalinity, conductivity and total dissolved solids, observed with the use of Principal Component Analysis. The authors attributed this to the eclipse effect that attenuated one of the variables against the others.

3.2 Application of the Trophic State Index - TSI

The application of TSI assisted in the evaluation of the eutrophication tendency of the hydric bodies under study. There was no significant difference between the median of chlorophyll-a samples ($p>0.05$) by the Kruskal-Wallis test, both for the dry and rainy periods, which demonstrated that there is no influence of seasonality on the data. The total phosphorus variable showed significant difference ($p<0.05$), this parameter varied expressively in each one of the sampling campaigns, that is, there was influence of seasonality. ANOVA statistical evaluations were performed using the PAST - Paleontological STatistics software.

The minimum, maximum, mean and standard deviation of the chlorophyll-a and total phosphorus variables of 15 sampling stations in the rainy and dry season can be observed in Table 5.

Table 5. Descriptive statistics for total phosphorus (TP), chlorophyll-a (CL) and for the Trophic State Index of the Irrigated Perimeter of Cotinguiba/Pindoba, Sergipe, Brazil

Parameter	Minimum	Maximum	Mean	Standard deviation
CL ($\mu\text{g L}^{-1}$) rainy	0.24	13.21	4.028667	3.895484
CL ($\mu\text{g L}^{-1}$) dry	0.24	11.77	3.975333	3.624435
TP (mg L^{-1}) rainy	0.004	0.524	0.0394	0.1340905
TP (mg L^{-1}) dry	0.012	0.284	0.06813333	0.08812075

In the Water Quality Assessment Program, which comprised two campaigns, dry season and rainy season, CODEVASF (2014) attributes the phosphorus concentrations found in the water to the use of agrochemicals from agricultural areas, which can later be deposited at the bottom of rivers and lakes, which can be released into the water through biochemical processes. Besides this, other sources of phosphorus can be cited, such as the discharge of untreated household effluents from the irrigated perimeter housing plots.

It was found that during the dry season in January 2014, the station with the highest concentration of chlorophyll-a, $11.77 \mu\text{g L}^{-1}$, was PIII-13-A Station, which is located in the water sluice of Lot 400 - Drainage of fish farming lot (Figure 5). During the dry season, the PV-09-A Station, drainage of a rice growing lot, had a concentration of $13.21 \mu\text{g L}^{-1}$.

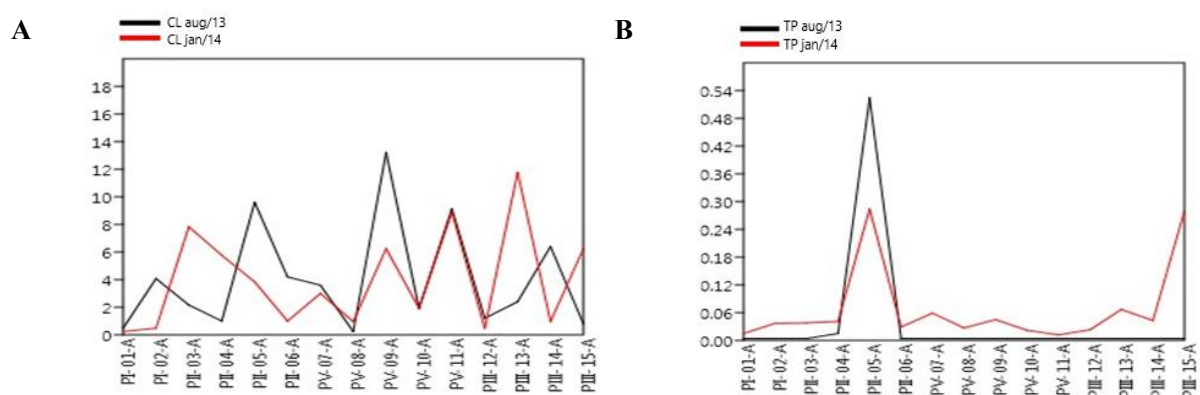


Figure 5. Chlorophyll-a concentrations ($\mu\text{g L}^{-1}$) at Cotinguiba-Pindoba Irrigated Perimeter sampling stations (A); Total phosphorus concentrations (mg L^{-1}) at Cotinguiba-Pindoba Irrigated Perimeter sampling stations (B).

All stations presented inverse values scale according to seasonality, for chlorophyll-a, with the exception of the PV-11-A Station, with concentration between $8.89 \mu\text{g L}^{-1}$ and $9.13 \mu\text{g L}^{-1}$ in the rainy and dry season, respectively. This last station is located in the drainage at the Pumping and Drainage Station02, located on the San Francisco River, which receives influence from all agricultural and fish farming lots. Total phosphorus concentrations in the rainy season were mostly below 0.004 mg L^{-1} , with the exception of the results in PII-04-A and P-II-05-A stations, the first being fish farming drainage and the second being rice growing. The P-II-05-A Station, during the dry season, also had one of the highest

concentrations, 0.284 mg L^{-1} .

The MTSI values can be observed by the Lamparelli methodology (2004) in Figure 6. It was found that in most sampling stations, the MTSI was lower in the rainy season, 2013, compared to the dry season, 2014.

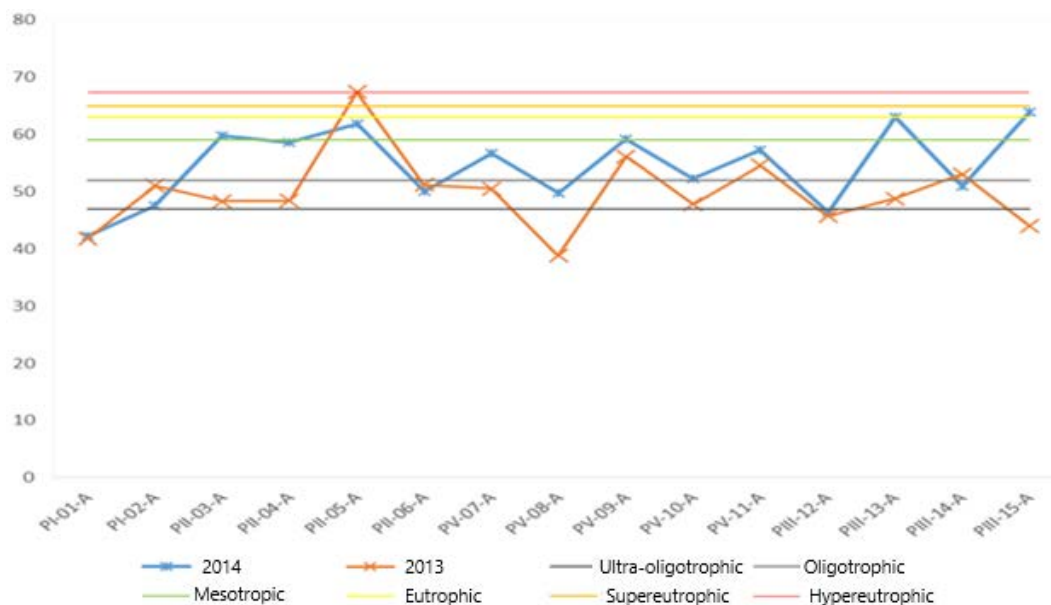


Figure 6. Temporal and spatial analysis of Mean Trophic State Index (MTSI) of Lamparelli (2004) in the Cotinguiba/Pindoba Irrigation Project, Sergipe, Brazil.

Santana et al. (2015) also found higher MTSI values in the dry period than in the rainy period, when analyzing the index in the Pilões, Papagaio and Capivara rivers, in Sergipe State, Brazil. The authors attributed this variation to the increase in temperature and consequently the proliferation of algae.

The maximum MTSI was 63.95 during the dry season, which classifies the water body as super-utrophic, a condition that can cause undesirable changes in water quality, such as the occurrence of episodes of algae blooms and interference in their multiple uses. This condition was observed in PIII-15-A Station, located in drainage of a rice growing lot, as detailed in Table 1.

The maximum value of MTSI was 67.45 in the PII-05-A Station, drainage of rice growing. The other stations presented MTSI values that classified them as mesotrophic, oligotrophic and ultraoligotrophic (Figure 6).

The box-plots of Figure 7 presented a spatial evaluation of the MTSI during the rainy season and the dry season. The MTSI upstream of the irrigation perimeter was lower than the index of the sampling stations located downstream. This demonstrated that the anthropic activities performed in the Cotinguiba/Pindoba Perimeter, mainly agriculture and fish farming, contributed to the increase of the total phosphorus nutrient in the aquatic environment. CODEVASF (2014) reported on the significant presence of macrophytes in the perimeter water drainage.

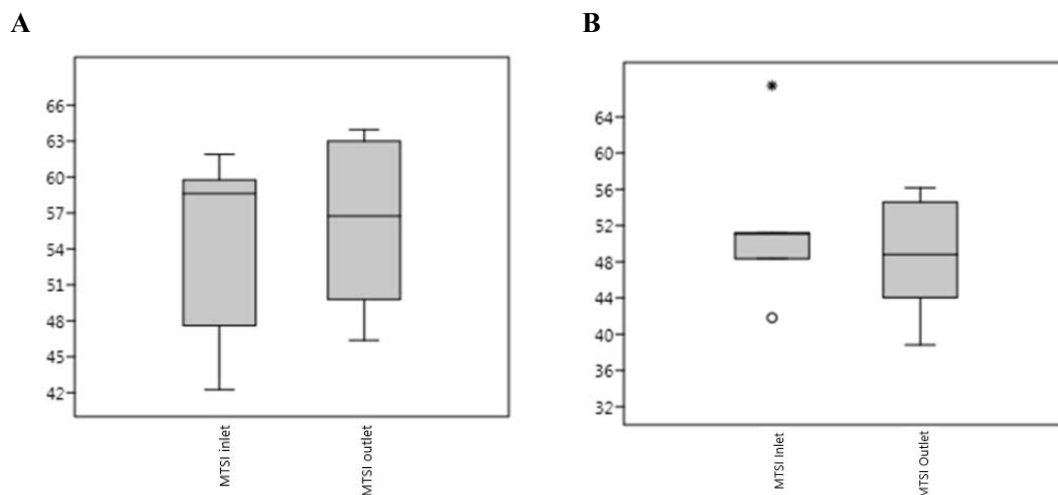


Figure 7. MTSI box-plot with spatial trends, water inlet and outlet stations in the irrigation perimeter, in the rainy season (A) and the dry season (B).

Assessing the box plot quartiles in the rainy period, an atypical value was recorded, 67.45 (hypereutrophic), that significantly departed from the general trend of variation of the other elements of the sample, which may be the result of observations with gross errors or simply the manifestation of very rare events (Naghetini and Pinto 2007).

This value can mean error in sampling, laboratory analysis or a point source of pollution at the time of collection, so it was decided not to remove the sample. In this case, the index value was influenced by the phosphorus concentration, 0.524 mg L^{-1} . In the analyses of the State Water Resources Plan when evaluating physical parameters of water quality, total phosphorus varied from 0.02 to 0.08 mg L^{-1} in the Lower San Francisco region. High phosphorus concentrations may be related to the drainage of nutrient-rich waters that are drained from the lots (Brito et al. 2016).

Considering the arithmetic averages of MTSI (Table 6), the rainy period would be characterized as oligotrophic, condition of clean water bodies, very low productivity and insignificant concentrations of nutrients. The dry season would fit as mesotrophic, a characteristic that attributes to the water body possible implications on water quality, but at acceptable levels in most cases.

Table 6 - Mean Trophic State Index of Lamparelli (2004), description of characteristics and location of sampling stations in the Cotinguiba/Pindoba Perimeter, Sergipe, Brazil

Station	Dry Season	MTSI	Rainy Season	MTSI	Characteristic and location of the sampling station
PI-01-A	42.2557	ultra-oligotrophic	41.8233	ultra-oligotrophic	Surface Water-Primary Source I-PI-01-A - In the bed of the San Francisco River by the 100 meters the upstream
PI-02-A	47.6003	oligotrophic	51.0857	oligotrophic	Surface Water-Primary Source I-PI-02-A - At least 100 meters upstream of the EB01 in the São Francisco Riverbed
PII-03-A	59.7533	eutrophic	48.3330	oligotrophic	In the water sluice of lot 394 – Fish farming
PII-04-A	58.6293	Mesotrophic	48.4324	oligotrophic	In the water sluice of lot 400 – Fish farming

PII-05-A	61.8928	eutrophic	67.4537	Hypereutrophic	In the water sluice of lot 337 – rice growing
PII-06-A	50.1443	oligotrophic	51.2111	oligotrophic	In the water sluice of lot 495 – rice growing
PV-07-A	56.7436	Mesotrophic	50.5439	oligotrophic	Perimeter Drainage/Collector V - At the entrance of the Estiva stream in Lot 357 rice growing
PV-08-A	49.7821	oligotrophic	38.8233	ultra-oligotrophic	Perimeter Drainage/Collector V - At the entrance of the Pilões stream in Lot 389 – rice growing
PV-09-A	59.2169	eutrophic	56.1706	Mesotrophic	Perimeter Drainage/Collector V - At the entrance of the Mussuípe stream in Lot 237 - rice growing
PV-10-A	52.2502	Mesotrophic	47.8233	oligotrophic	Perimeter Drainage/Collector V - In Drainage of EB 1102 EBD 01
PV-11-A	57.3094	Mesotrophic	54.5718	Mesotrophic	Perimeter Drainage/Collector V - In Drainage of EB 1602 EBD 02
PIII-12-A	46.3657	ultra-oligotrophic	45.7891	ultra-oligotrophic	Lot drainage in the water sluice of lot 394 - Fish farming
PIII-13-A	62.9900	eutrophic	48.7891	oligotrophic	Lot Drainage in the water sluice of lot 400 - Fish farming
PIII-14-A	50.9905	oligotrophic	53.0342	Mesotrophic	Lot Drainage in the water sluice of lot 337 – rice growing
PIII-15-A	63.9573	Supereutrophic	44.0342	ultra-oligotrophic	Lot Drainage in the water sluice of lot 495 – rice growing

The arithmetic mean of the MTSI both in and out, rainy and dry periods, were similar, fitting as oligotrophic and mesotrophic, respectively. Despite the unstable results that framed the stations in all the trophic state indexes, there was no significant difference (Kruskal-Wallis, $p > 0.05$), between the MTSI, for input and output, in the two time periods.

Fia (2009) evaluated the Trophic State Index in the watershed of Lagoa Mirim, RS, Brazil and found that the behavior of this index in the region is unstable, the authors attributed this variability to the diffuse contribution of irrigated rice crops, which return this water to the environment with chemical and organic phosphate fertilizers and also to domestic sewage.

The results obtained by Santos et al. (2018) allowed us to say that the behavior of the TSI along the Sapucaia Coastal watershed in Sergipe is stable, considering the occurrence of periods in which the values achieved become critical, especially for the deterioration in water quality, due to the characteristics of the surrounding water bodies of this watershed.

4. Conclusions

The Water Quality Index (WQI) varied from bad to good during the dry season and from regular to good during the rainy season, proving the seasonal influence.

The arithmetic average of the indices was classified as regular WQI.

No spatial influence on WQI results was evidenced, which may be related to the eclipse effect, attenuation of the negative impact of a certain variable given the aggregation of numerous variables.

The results of the trophic state classification, using the Trophic State Index (TSI) modified by Lamparelli, showed that there is an influence of seasonality, since the best indices were obtained in the rainy season, characterized as oligotrophic.

There was interference from the drainage of rice growing lots in the dry period, contributing to the increase of nutrients, in this period the MTSI was framed in mesotrophic.

5. Acknowledgments

Acknowledgements to the Graduate Program in Water Resources - PRORH and the Federal University of Sergipe for their support to the research and publication of this article.

6. References

Alves, I.C.C., El-Robrini, M., Santos, M. de L.S., Monteiro, S. de M., Barbosa, L.P.F., Guimarães, J.T.F. (2012). Qualidade das águas superficiais e avaliação do estado trófico do Rio Arari (Ilha de Marajó, norte do Brasil). *Acta Amazônica*, 42(1):115-124. <https://doi.org/10.1590/S0044-59672012000100014>

Andrietti, G., Freire, R., Amaral, A.G. de, Almeida, F.T. de, Bongiovani, M.C., Schneider, R.M. (2016). Índices de qualidade da água e de estado trófico do rio Caiabi, MT. *Ambiente & Água*, 11(1):162-175. <https://doi.org/10.4136/ambi-agua.1769>

Barros, D.A., Silva, B.M., Silva, R.A., Pereira, J.A.A., Borges, L.A.C., Pereira E.L., Nascimento, G.O. (2014). Atributos físicos e pH de um fragmento do rio Taquari sob a mineração de bauxita no planalto de Poços de Caldas – MG. *Holos*, 4:78-88. <https://doi.org/10.15628/holos.2014.1378>

Barros, R.V.G., Souza, C.A. (2013). Uso do Solo da Sub-bacia do Córrego André e Qualidade da Água em Mirassol D'Oeste - MT. *Revista de Geografia*, 30(1):55-72.

Barros, R.V.G., Souza, H.M. de L., Souza, C.A. de. (2011). Determinação do índice de qualidade da água (IQA) na sub-bacia no córrego André em Mirassol D'oeste, Mato Grosso. *Engenharia Ambiental*, 8(3):138-153.

Batista, A.A., Meireles, A.C.M., Andrade, E.M. de, Izidio, N.S. de C., Lopes, F.B. (2014). Sazonalidade e variação espacial do índice de estado trófico do açude Orós, Ceará, Brasil. *Revista Agro@mbiente On-line*, 8(1):39-48. <https://dx.doi.org/10.18227/1982-8470ragro.v8i1.1362>

Blume, K.K., Macedo, J.C., Meneguzzi, A., Silva, L.B., Quevedo, D.M., Rodrigues, M.A.S. (2010). Water quality assessment of the Sinos River, Southern Brazil. *Brazilian Journal of Biology*, 70(4):1185-1193. <https://doi.org/10.1590/S1519-69842010000600008>

Brito, F.B., Silva, T.M.M., Vasco, A.N., Aguiar Netto, A.O., Carvalho, C.M. (2016). Impactos da

produção do arroz inundado na qualidade da água do Rio Betume, Sergipe. *Revista Agropecuária Técnica*, 37(1):44-54. <https://doi.org/10.25066/agrotec.v37i1.25254>

Bucci, M.H.S., Oliveira, L.F.C. (2014). Índices de qualidade da água e de estado trófico na represa Dr. João Penido (Juiz de Fora, MG). *Revista Ambiente & Água*, 9(1):130-148. <https://doi.org/10.4136/ambi-agua.1290>

Buzelli, G.M., Cunha-Santino, M.B. (2013). Análise e diagnóstico da qualidade da água e estado trófico do reservatório de Barra Bonita (SP). *Revista Ambiente & Água*, 8(1):186-205. <https://doi.org/10.4136/ambi-agua.930>

Carvalho, L.L.S., Lacerda, C.F., Lopes, F.B., Carvalho, C.M., Gomes Filho, R.R., Araújo Filho, R.N. (2017). Influence of Prolonged Drought on Groundwater Quality: Irrigated Perimeter of Lower Acaraú – State of Ceará– Northeast of Brazil. *Journal of Experimental Agriculture International*, 18(3):1-14. <https://doi.org/10.9734/JEAI/2017/36480>

Carvalho, L.L.S., Lacerda, C.F., Carvalho, C.M., Lopes, F.B., Andrade, E.M., Gomes Filho, R.R. (2020). Variabilidade espaço-temporal na qualidade das águas subterrâneas em área irrigada no semiárido brasileiro. *Research, society and development*, 9(8):1-24. <https://doi.org/10.33448/rsd-v9i8.5786>

CETESB. - Companhia Ambiental do Estado de São Paulo-. Índice de Qualidade das Águas. São Paulo, 2005.

CODEVASF. Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba-. Diagnóstico Ambiental dos Perímetros Irrigados da Codevasf – 4ª Superintendência Regional. Aracaju-Sergipe, 2005, 134 p.

CODEVASF. Companhia de Desenvolvimento dos Vales do São Francisco e do Parnaíba - Programa de Avaliação das Águas e Sedimentos dos Perímetros Irrigados Cotinguiba/Pindoba - CODEVASF, Relatório Final, Sergipe: 4ª Superintendência Regional, 2014, 44 p.

Cordeiro, E.M.S., Rocha, F.N.S., Pequeno, M.N.C., Buarque, H.L.B., Gomes, R.B. Avaliação comparativa dos índices de estado trófico das lagoas do Opaia e da Sapiranga, Fortaleza-CE. In: IX Encontro de Pesquisa e Pós-Graduação, IX Encontro de Iniciação Científica, III Simpósio de Inovação Tecnológica, 2009, Fortaleza. Anais... Fortaleza, 2009.

Costa, A.B. da, Posselt, E.L., Menezes, C.M., Lobo, E.A. (2012). Desenvolvimento e aplicação de índices de qualidade da água. *Caderno de Pesquisa*, 24(1):69-77. <https://dx.doi.org/10.17058/cp.v24i1.4398>

Ferreira, K.C.D.; Lopes, F.B.; Andrade, E.M. de; Meireles, A.C.M.; Silva, G.S. da. (2015). Adaptação do

índice de qualidade de água da National Sanitation Foundation ao semiárido brasileiro. *Revista Ciência Agronômica*, 46(2):277-286. <https://dx.doi.org/10.5935/1806-6690.20150007>

Fia, R.; Matos, A.T. de; Coradi, P.C., Ramirez, O.P. (2009). Estado trófico da água na bacia hidrográfica da Lagoa Mirim, RS, Brasil. *Ambiente & Água*, 4(1):132-141. <https://dx.doi.org/10.4136/ambi-agua.78>

Frinhani, E.M.D., Carvalho, E. (2010). Monitoramento da qualidade das águas do rio do Tigre, Joacaba, SC. *Unesco & Ciencia – ACET*, 1(1):49-58.

IBGE. Instituto Brasileiro de Geografia e Estatística. *Uso da Terra no Estado de Sergipe (Relatório Técnico)*. Rio de Janeiro:IBGE, 195p., 2011.

Lamparelli, M.C. Grau de trofia em corpos d'água do Estado de São Paulo: avaliação dos métodos de monitoramento. Tese (Doutorado em Ciências), Universidade de São Paulo, São Paulo, 2004.

Massoud, M.F. (2012). Assessment of water quality along a recreational section of the Damour River in Lebanon using the water quality index. *Environmental Monitoring and Assessment*, 184(7):4151-4160. <https://doi.org/10.1007/s10661-011-2251-z>

Naghattini, M., Pinto, E.J.A (Coords.). *Hidrologia Estatística*. Belo Horizonte: CPRM, 552 p., 2007.

Pontes, P.P., Marques, A.R., Marques, G.F. (2012). Efeito do uso e ocupação do solo na qualidade da água na micro-bacia do Córrego Banguelo – Contagem. *Revista Ambiente & Água*, 7(3):598-613. <https://doi.org/10.4136/ambi-agua.962>

Santana, N.R.F., Aguiar Netto, A.O., Nascimento Filho, J.C.B., Silva S.B. (2015). Índice de Estado Trófico e Uso na Irrigação: Importância Ecológica e Qualitativa para a Sustentabilidade no Baixo São Francisco. In: XXV CONIRD – Congresso Nacional de Irrigação e Drenagem, 2015, São Cristóvão. Anais... São Cristóvão, 2015.

Santos, M.G., Santino, M.B.C., Junior, I.B. (2011). Alterações espaciais e temporais de variáveis limnológicas do reservatório do Monjolinho (campus da Ufscar). *Oecologia Australis*, 15(3):682-696. <https://doi.org/10.4257/oeco.2011.1503.18>

Santos, R.C.L.; Lima, A.S.; Cavalcanti, E.B.; Melo, C.M.; Marques, M.N. (2018). Aplicação de índices para avaliação da qualidade da água da Bacia Costeira do Sapucaia em Sergipe. *Engenharia Sanitária e Ambiental*, 23(1):33-46. <https://doi.org/10.1590/S1413-41522017159832>

Silva, G.S; Jardim, W.F. (2006). Um novo índice de qualidade das águas para proteção da vida aquática aplicado ao Rio Atibaia, região de Campinas/Paulinia - SP. *Química Nova*, 29(4):689-694.

<https://doi.org/10.1590/S0100-40422006000400012>

Simões, F.S., Yabe, M.J.S., Moreira, A.B., Bisinoti, M.C. (2007). Avaliação do efeito da piscicultura em sistemas aquáticos em Assis e Candido Mota, São Paulo, por indicador de qualidade da água e análise estatística multivariada. Química Nova, 30(8):1835-1841. <https://doi.org/10.1590/S0100-40422007000800008>

Veríssimo, F.A. dos R., Ferreira, M.I.P. (2013). Aplicação do índice de qualidade da água (IQA) para caracterização do baixo curso do Rio São João. Boletim do Observatório Ambiental Alberto Ribeiro Lamego, 7(2):181-197. <https://doi.org/10.5935/2177-4560.20130021>

Zanini, H.L.H.T., Amaral, L.A., Zanini, J.R., Tavares, L.H.S. (2010). Caracterização da água da microbacia do córrego rico avaliada pelo índice de qualidade de água e de estado trófico. Engenharia Agrícola, 30(4):732-741. <https://doi.org/10.1590/S0100-69162010000400017>

Diagnostic aspects of juvenile ossificant fibroma: A case study

João Paulo Martins de Oliveira¹; Maria Caroline Ferreira Cardoso¹; Ana Paula Silva Lopes¹; Aline Reis Stefanini²; Paulo Henrique Bortoluzo³; André Luís da Silva Fabris⁴; Tais Cristina Nascimento Marques⁵; Rogério Rodrigo Ramos^{6,7*}; Nilton Cesar Pezati Boer⁸; Luciana Estevam Simonato⁹

¹School of Dentistry, Universidade Brasil, Fernandópolis, SP, Brazil

²Specialization in Medical Residency, Professor of the Department of Pathology, Universidade Brasil, Fernandópolis, SP, Brazil.

³Master's in Periodontics, Professor of the Postgraduate Program in Implantology, Universidade Brasil, Fernandópolis, SP, Brazil.

⁴PhD in Buccomaxillofacial Surgery and Traumatology, Professor of the Postgraduate Program in Implantology, Universidade Brasil, Fernandópolis, SP, Brazil.

⁵PhD in Dentistry, Professor at the School of Dentistry, Centro Universitário de Brasília-UDF, Brasília, DF, Brazil.

⁶PhD in Health Sciences, Professor at the School of Dentistry, Universidade Brasil, Fernandópolis, SP, Brazil.

⁷Bentham Science Ambassador, Fernandópolis, SP, Brazil.

⁸PhD in Biomedical Engineering, Professor at the Department of Integrated Dentistry Clinics and the Postgraduate Program in Bioengineering, Universidade Brasil, Fernandópolis, SP, Brazil.

⁹PhD in Biomedical Engineering, Professor of the Department of Clinical Propaedeutics and the Postgraduate Program in Bioengineering, Universidade Brasil, Fernandópolis, SP, Brazil.

*Corresponding author:

e-mail address: rogerio.enfer@gmail.com tel. +55 17 3465 4200

Abstract

Juvenile ossifying fibroma is an uncommon, fast-growing benign neoplasm classified within the group of fibro-osseous lesions that directly affect the face and the jaws. Although it is not followed by metastasis, it usually presents a highly aggressive nature. It is histopathologically divided into two patterns: trabecular and psammomatoid. It can be differentiated through the age of the patients, anatomic location and behavior of the lesion. In this context, this paper reports on the findings of a rare pathology case: juvenile ossifying fibroma, focusing primarily on its clinical, medical imaging and histopathological features characteristics, in order to familiarize the dentist, provide correct diagnosis and the most appropriate treatment.

Keywords: Ossifying fibroma; Oral pathology; Oral surgery; Oral diagnosis; Oral rehabilitation;

1. Introduction

There is a significant diversity of fibro-bone lesions that occur in the face and the jaws, it is characterized by the replacement of the normal bone by a fibrous tissue containing a newly formed mineralized product^[1,2].

These lesions were first described in 1938 in a case of juvenile psammomatoid ossifying fibroma, known, at the time, as an atypical osteoid fibroma with ossification of the frontal sinus^[3]. Eleven years later, there were two histopathologically similar reports on children's paranasal sinuses, after that, this pathology was renamed as a psammomatoid ossifying fibroma^[4].

In 1952, the same lesion was named as active juvenile ossifying fibroma and it was described as a kind of aggressive ossifying fibroma, occurring more often in younger children^[5]. Some years later, in 1965, two other authors described two cases of juvenile trabecular ossifying fibroma in two children, they were the first ones to report such a variant^[6].

Juvenile ossifying fibroma is a fast-growing benign neoplasm. Although it is not followed by metastasis, it still presents a highly aggressive nature^[7]. It is histopathologically divided into two patterns: trabecular and psammomatoid^[8]. Despite being similar to other fibro-osseous lesions, it can be differentiated through the age of the patients, common anatomic locations and behavior of the lesion^[9].

The age for its occurrence is variable, ranging from 6 months to 70 years^[10]. However, the majority of reported cases are patients under 15^[11]. It also affects more male than female patients and it is associated with the congenital absence of teeth, however, there are no records of malignant transformation^[1,8]. It can occur in both gnathic bones, the maxilla being the most common local. Its recurrence rate varies between 30% to 58%, which could be associated with incomplete tumor removal^[12,13].

Clinically, there may be painless bone expansion which, in association with faster lesion development, leads to facial deformity characterized by the presence of swellings or deformities^[14]. There are no local phlogistic signs and, paresthesia or pain is rare^[15]. They are able to reach the paranasal sinuses, orbit or maxilla, and it may potentially cause nasal obstruction, proptosis and intracranial involvement^[9,16].

Radiographically, the lesions are circumscribed radiolucent, unilocular or multilocular^[2,15]. Margins may get thinner in more aggressive lesions^[14,17]. In certain cases, it is possible to observe central radiopacities and a line between the tumor and healthy bone tissue. In some cases, it is also possible to observe ground-glass opacity. Still, when the tumor is inside the sinus, it can appear radiodense and fog-like aspect and, thus, be confused with sinusitis^[10,13,18].

Both histological patterns are not encapsulated, presenting themselves as well-defined masses having more fibrous cellular connective tissue in some of its areas than in others. Myxomatous foci can be found and it is often associated with pseudocystic degeneration^[19]. Mitotic figures can be found in fewer numbers^[11]. Bleeding and small clusters of multinucleated giant cells may be observed^[10]. The mineralized tissue in the two patterns is very different; the trabecular type has irregular clusters of highly cellular osteoid typically including bulky and irregular osteocytes. However, the psammomatoid type shows concentric lamellae and spherical ossicles which vary in shape, having basophilic centers with an eosinophilic peripheral osteoid margin^[12,14].

The treatment for juvenile ossifying fibroma is defined in terms of tumor's behavior and stage. Many

reports state that conservative interventions such as curettage and enucleation of the lesion, presented better results, but only in less aggressive cases^[16,19]. When the tumor is too big along with a fragile bone cortex, tooth displacement or resorbed roots, the common procedure is to have a block resection with clear tumor margins and bone graft reconstruction^[17].

The present study reports a case of juvenile ossifying fibroma, a rare and rapidly developing pathology^[7], which, if not diagnosed and treated in its early stages may present excessive local aggressiveness, directly affecting dental positioning and facial symmetry and in rarer cases, the noble anatomic structure, result in patient's death^[18]. A primary focus is given to its clinical, visual and histopathological characteristics, which are fundamental for the identification, correct diagnosis and appropriate treatment for the lesion.

2. CLINICAL CASE REPORT

Female patient, 14 years old, parda/mulatta, was admitted in the Centro de Especialidade Odontológicas (CEO), Fernandópolis/SP, complaining of facial swelling which started approximately 2 months earlier. No risk habits or pre-existing systemic changes were reported during the anamnesis.

An extraoral cavity examination was performed (Figure 1) and a slight facial asymmetry with slight swelling was found on the left labial commissure of the mouth, there were no signs of inflammation, asymptomatic and fibrous on palpation. The local was normochromic, with no lymphadenopathy or any other alteration.



Figure 1. Physical appearance of the face. It is possible to observe a slight swelling on the left side of the maxillary-zygomatic region.

During the intraoral cavity examination (Figure 2), swelling was observed at the left upper alveolar ridge, expanding through both the buccal and palatal regions and covering the premolars and the entire

hard palate. There was crowding of the teeth, however, there were no signs of displacement. The lesion was covered by intact and normochromic mucosa and was asymptomatic and hard on palpation.



Figure 2. Early intraoral appearance. There is a significant increase in the premolar region on the left side.

The patient had a panoramic radiograph (Figure 3) which showed a circumscribed unilocular "ground-glass opacity" between teeth 24 and 25, with slight displacement.

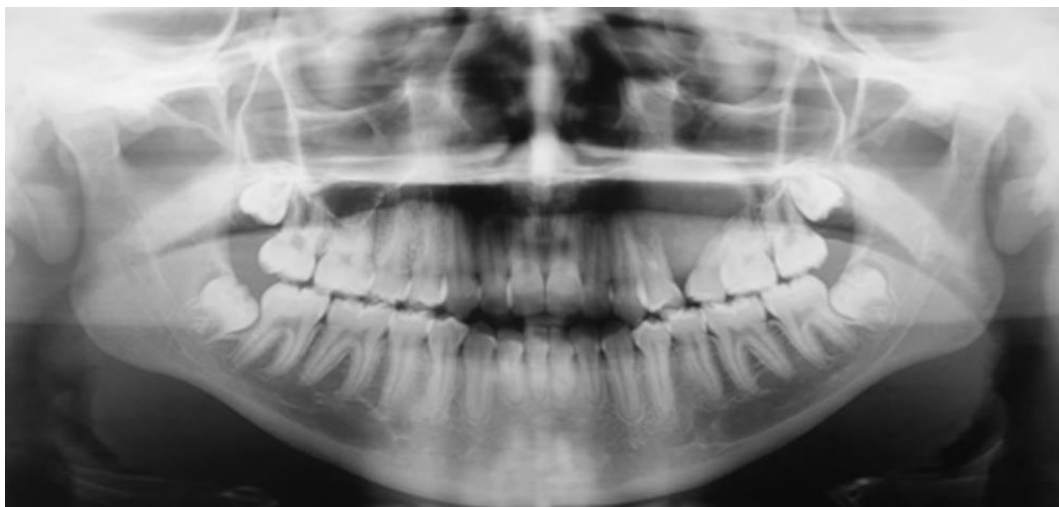


Figure 3. First panoramic radiograph. It indicated the presence of a circumscribed radiopaque unilocular lesion causing displacement of the 24 and 25 elements.

Then, a computed tomography (Figures 4, 5 and 6) was requested, which showed a hyperdense, homogeneous, well-defined image of osteolytic character and apparent disorganization of the medullary bone. The lesion was shown to be expansive, indicating bone cortices and adjacent structures displacement (maxillary sinus, nasal fossa floor and alveolar process). Teeth 24 and 25 were dislocated and there was external root resorption on the 23, 24, 25 and 26 elements.

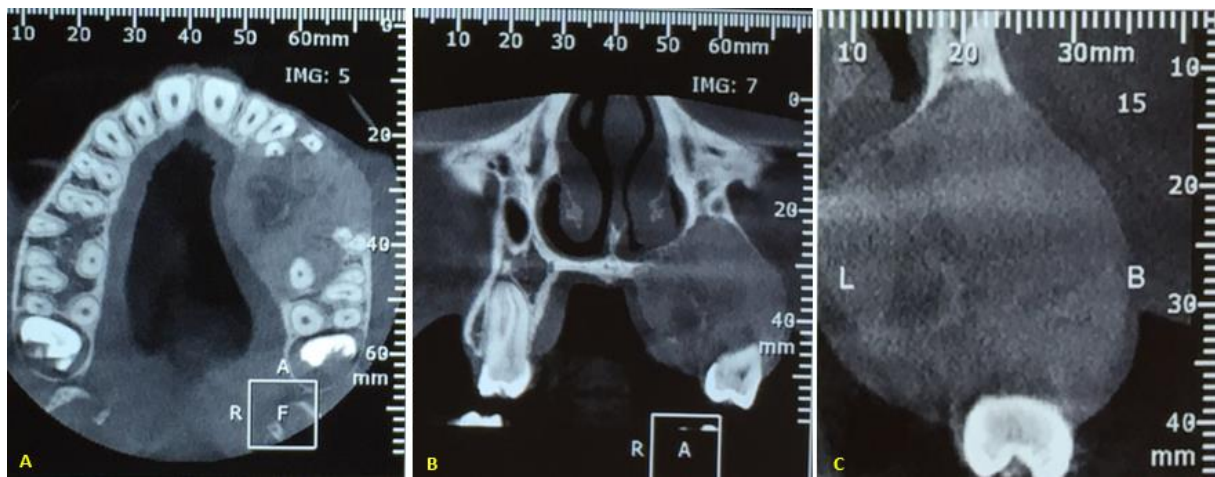


Figure 4. First CT scan. It is possible to observe some expansion of the vestibular and palatal bone margin, involving the 23, 24, 25 and 26 teeth, apical reabsorption, invasion of the maxillary sinus and nasal cavity floor. A: axial cut. B: coronal cut. C: oblique cut.

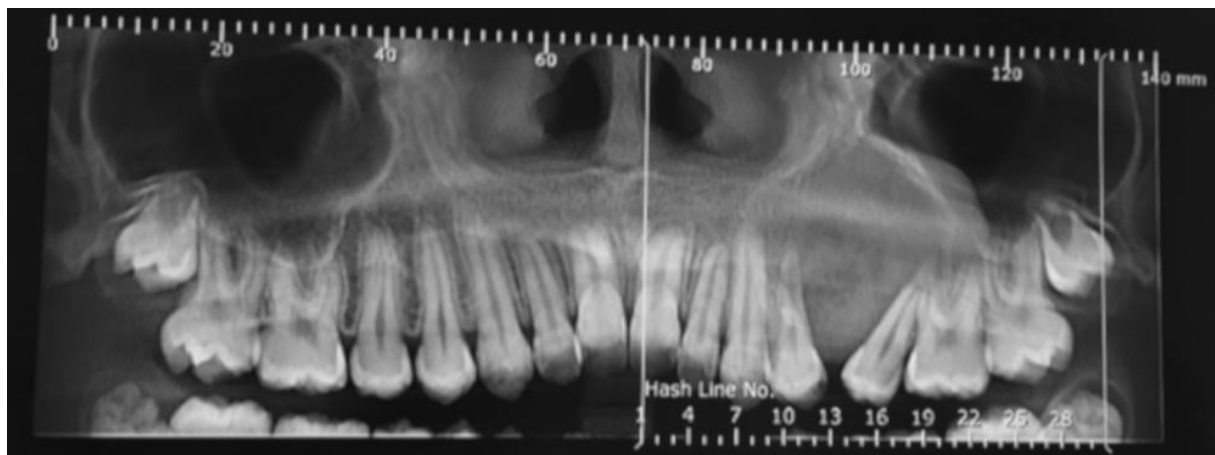


Figure 5. Panoramic reconstruction of the first CT showing the extent of the lesion and involvement of the teeth 23, 24, 25 and 26; teeth displacement and the anterior wall and floor of the maxillary sinus.



Figure 6. 3D reconstruction of the first CT scan indicating bone tissue loss at the injury location and its extension.

The clinical and imaging results strongly suggested fibrous dysplasia or ossifying fibroma as a differential diagnosis. Therefore, an incisional biopsy was performed (Figure 7) through intraoral cavity, and the collected material was conditioned and sent to further analysis.

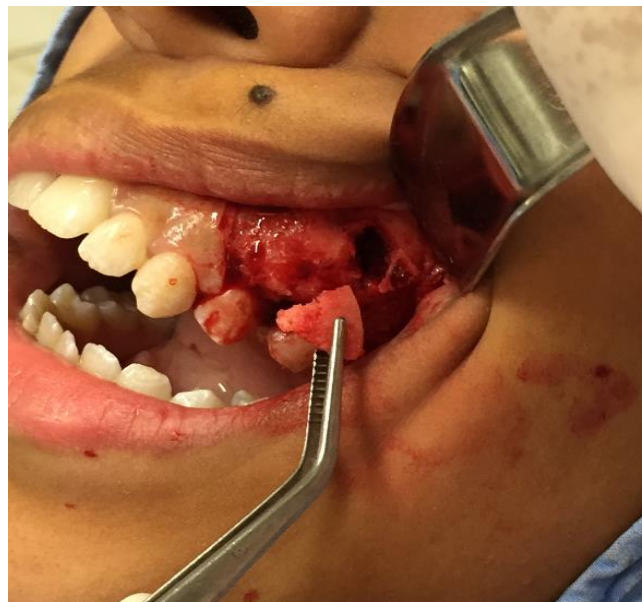


Figure 7. Material collected from the incisional biopsy, through intraoral access, and taken to anatomopathological analysis.

The anatomopathological result showed a non-encapsulated lesion with irregularly shaped immature bone trabeculae in a loosely arranged fibrous cell stroma, suggests fibrous dysplasia to a greater extend (Figure 8). However, certain areas were more disorganized, presenting a mixture of immature and lamellar

bone, which is compatible with ossifying fibroma. Thus, the histopathological diagnosis detected a benign mesenchymal neoplasia, indicating complete excision of the tumor for a definitive diagnosis.

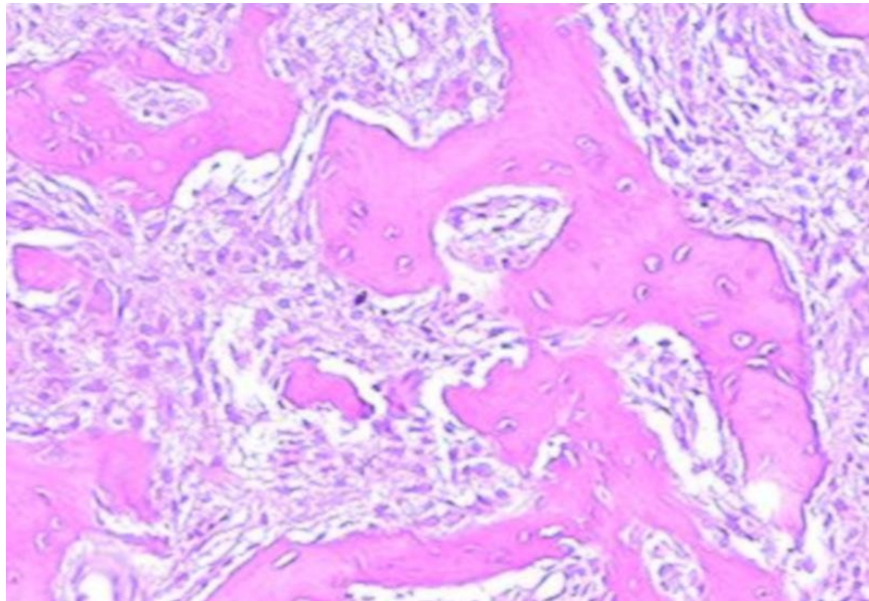


Figure 8. Histopathological aspect showing immature bone trabeculae and lamellar bone in a loosely arranged fibrous cell stroma - H.E. (200x).

The patient was referred to the Hospital de Base of São José do Rio Preto / SP and two months after the first surgical procedure (incisional biopsy), the enucleation of the lesion was performed through intraoral access in a hospital environment under general anesthesia. The removed part was properly packed and sent for further histopathological analysis, which confirmed the diagnosis of juvenile ossifying fibroma.

After six months of follow-up, a new panoramic radiograph (Figure 9) and computed tomography (Figure 10) were taken. Both, the imaging tests and the clinical aspect (Figure 11), indicated no signs of recurrence. The patient remained asymptomatic, without paresthesia, with no mobility in the adjacent teeth and normal facial appearance.



Figure 9. Panoramic radiograph after a 6 six months postoperative period showing the absence of teeth 24, 25 and 26, which were removed along with the lesion, it also indicates the presence of cortical bone line on the anterior wall and nasal sinus floor with no signs of oroantral communication.

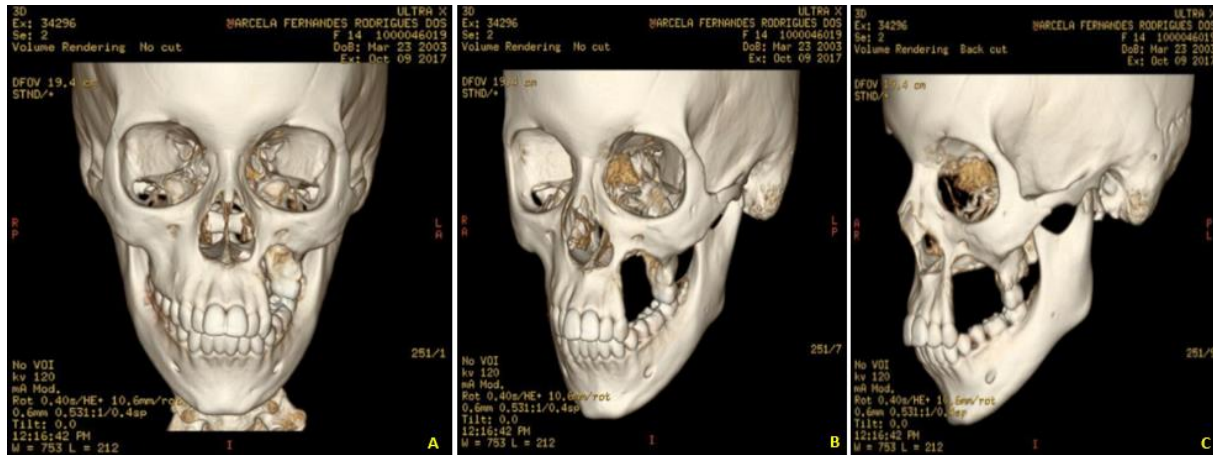


Figure 10. 3D reconstruction of CT scan after 6 months postoperative period showing where the enucleation was performed.



Figure 11. Intraoral appearance 6 months after the operation. It is observed absence of the 24, 25 and 26 teeth, healthy mucosa, without periodontal disease, without oroantral communication.

In order to be able to have an adequate life condition and to keep her aesthetic and masticatory functions. The patient was rehabilitated using a maxillofacial prosthesis (Figure 12) due to the significant tissue loss during the procedure.



Figure 12. Oral rehabilitation using maxillofacial prosthesis, enabling aesthetics and masticatory function.

3. Discussion

Juvenile ossifying fibroma is a fibro-osseous lesion with rapid development and great local aggressiveness^[7,9,14], the case study in this paper presented a patient with an expansive tumor, teeth and bone cortical displacement, which led to facial asymmetry within two months' time.

Its occurrence is more common in patients under 15 and male patients are slightly more affected than female, it can reach both gnathic bones, but the most common location is maxilla^[8,18]. In this case report, the age group and location matched the existing literature, there were no significant relevance regarding gender for the differential diagnosis of the lesion.

The radiographic examination indicated the lesions to be well-defined radiolucent, unilocular or multilocular, with central radiopacities and ground-glass opacity^[2,11] in cases like this. CT scans and MRIs can also provide a better visualization of the affected bone and structures, the latter being important when there is ocular and neurovascular involvement^[1,12,13].

Two histopathological patterns could be observed: psammomatoid and trabecular. Both are shown as well-defined, non-encapsulated masses, differing each other due to the mineralized component^[8,10,11]. In this case report was not possible to define the exact pattern, even after a second analysis with a larger amount of material, because characteristics of the two variants were present. Thus, the pathology was referred only as juvenile ossifying fibroma.

The differential diagnosis is usually made with fibrous dysplasia^[15,19], it typically requires a complete anatomopathological analysis, as described in this case. Thus, the final diagnosis is reached by combining clinical, imaging and histopathological exams.

There are multiple options for treatment it and must be chosen according to the behavior and stage of the tumor. Many reports suggest that, in less aggressive situations, better results are obtained from conservative interventions, such as surgical enucleation, successfully performed on this patient. In more aggressive cases, less conservative treatments may be chosen, such as block resection with a safety

margin^[10,17]. This stage is of paramount importance since it is assumed that high rates of recurrence are associated with deficient removal of the lesion, which can range from 30 to 58% of cases^[13,16].

4. Conclusion

After the presenting this case study, it can be concluded that knowing the clinical, imagological and histopathological characteristics of juvenile ossifying fibroma favors its correct diagnosis and has profound influence on choosing the most appropriate treatment in each situation.

Conflicts of interest

The authors declare no conflict of interest.

5. References

- [1] L.M.G. Figueiredo, R.O.H. Valente, V.A. Sarmento, S.C. Trindade, T.F.L. Oliveira and W.R.M. Costa, Aspectos atuais no diagnóstico e tratamento do fibroma ossificante juvenil. *Rev Bras Cir Cabeça Pescoço*. 2012;41(2):99-102.
- [2] S.M. Gondivkar, A.R. Gadail, R. Chole, R.V. Parikh and S. Balsaraf, Ossifying fibroma of the jaws: report of two cases and literature review. *Oral Oncology*. 2011;47(9):804-809.
- [3] C.E. Benjamins, Das osteoid-fibrom mit atypischer verkalkung im sinus frontalis. *Acta Otolaryngol*. 1938;26:26-43.
- [4] H. Gögl, Das psammo-osteoid fibroma der nase und ihrer Nebenhöhlen. *Monatsschr Ohrenheilkd Laryngorhinol*. 1949;83:1-10.
- [5] L.C. Johnson, M. Yousefi, T.N. Vinh, D.K. Heffner, V.J. Hyams and K.S. Hartman, Juvenile active ossifying fibroma: its nature, dynamics and origin. *Acta Otolaryngol. Suppl* 1991;448:1-40.
- [6] R.J. Reed and D.M. Hagy, Benign non-odontogenic fibroosseous lesions of the skull: report of two cases. *Oral Surg Oral Med Oral Pathol*. 1965;19:214-27.
- [7] A. Suarez-Soto, M.C.B.R. Hermosa, I. Minguez-Martínez, L.M. Floría-García, J. Barea-Gámiz, J. Delhom-Valero and P. Risueño-Mata, Management of fibro-osseous lesions of the craniofacial area. Presentation of 19 cases and review of the literature. *Med Oral Patol Oral Cir Bucal*. 2013;18(3):479-485.
- [8] S. El-Mofty, Psammomatoid and trabecular juvenile ossifying fibroma of the craniofacial skeleton: Two distinct clinicopathologic entities. *Oral Surg, Oral Med, Oral Pathol, Oral Radiol Endod*. 2002;93(3):296-304.
- [9] J.G. Paiva, F. Böing, M.B. Benaglia and A. Nascimento, Fibroma ossificante: relato de 2 casos. *Rev. Cir Traumatol Buco-Maxilo-Fac*. 2009;9(1):33-40.
- [10] A.C. Chi, Patologia óssea. In: B.W. Neville, D.D. Damm, C.M. Allen and J.E. Bouquet, editores. *Patologia oral e maxilofacial*. 4 ed. Rio de Janeiro: Elsevier; 2016. p. 615-678.
- [11] L. Barnes, J.W. Eveson, P. Reichart and D. Sidransky, editors. *World Health Organization Classification of Tumours. Pathology and genetics of head and neck tumours*. Lyon: IARC Press; 2005.

- [12] B. Keles, M. Duran, Y. Uyar, A. Azimov, A. Demirkan and H.H. Esen, Juvenile Ossifying Fibroma of the Mandible: a Case Report. *J Oral Maxillofac Res.* 2010;1(2):1-7.
- [13] B.R. Peterson and B.L. Nelson, Juvenile Active Ossifying Fibroma. *Head Neck Pathol.* 2015;9(3):384-386.
- [14] S.F. Smith, L. Newman and D.M. Walker, Juvenile aggressive psammomatoid ossifying fibroma: an interesting, challenging, and unusual case report and review of the literature. *J Oral Maxillofac Surg.* 2009;67:200-206.
- [15] A.S. Espinosa, J. Villanueva, H. Hampel and D. Reyes, Spontaneous regeneration after juvenile ossifying fibroma resection: a case report. *Oral Surg, Oral Med, Oral Pathol, Oral Radiol Endod.* 2006;102(5):32-35.
- [16] A.J. Saiz-Pardo-Pinos, M.O.V. Olmedo-Gaya, E. Prados-Sánchez and M. Vallecillo-Capilla, Fibroma óseo juvenil: a propósito de un caso clínico. *Med oral Patol Oral Cir Bucal.* 2004;9:454-458.
- [17] M.E. Papadaki, M.J. Troulis and L.B. Kaban, Advances in diagnosis and management of fibro-osseous lesions. *Oral Maxillofacial Surg Clin N Am.* 2005;17:415-434.
- [18] S. Ram, A. Kumar, I. Ali, P. Wadhvani, A. Saxena and M.I. Ali, Juvenile ossifying fibroma of mandible. *Dentistry and Medical Reserch.* 2014;2(1):14-16.
- [19] R.L.M. Nogueira, C.F.W. Nonaka, R.B. Cavalcante, A.C. Carvalho and L.B. Souza, Fibroma ossificante juvenil localizado em mandíbula: relato de caso e breve revisão da literatura. *Rev Cir Traumatol Buco-Maxilo-fac.* 2009;9(1):25-32.

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/>).

An Analog Circuit Course Teaching Method Based on the Analysis of Classic Application Circuits

Qing Xiang (Corresponding author)

School of Intelligent Manufacturing, Jiangnan University,
430056, Wuhan, China.

Abstract

Analog circuit course is a compulsory professional basic course for engineering majors such as automation and electronic information engineering. Since traditional teaching methods cannot enable students to effectively master the knowledge of analog circuits, this article proposes a teaching method of analog circuits based on the analysis of classic application circuits, including the idea of selecting classic application circuits, "impression enhancement method of "reading, drawing and memorizing circuit diagram" and hands-on implementation of classic circuits. Through the practice of teaching reform for one semester, the results show that the teaching method enhances students' enthusiasm for learning, enables students to integrate theoretical knowledge, deeply understand application circuits, and then carry out practical applications or innovate on this basis.

Keywords: teaching method; analog circuit course; classic application circuit

1. Introduction

The analog electronic technology course is a compulsory professional basic course for automation, electronic information engineering, and other electrical engineering majors. It is a practical course that closely combines theory and practice to strengthen students' electronic technology practice capabilities. In traditional teaching, teachers mainly explain the theory step by step in accordance with the chapters of the textbook. Students often cannot analyze an actual comprehensive circuit after learning, so they cannot adapt to the requirements of electronic engineers from enterprises. With the development of modern science and technology, teaching methods are constantly changing, and various classroom presentation forms such as multimedia courseware, Flash animation, software simulation, etc. can be used. Although these information-based teaching methods are very popular, the classroom learning process still cannot get rid of the methods of teacher explanation, teacher operation, and teacher demonstration, and cannot stimulate the students' enthusiasm and subjective initiative. The main problems boil down to the fact that basic courses, theoretical courses, and application courses are not well integrated with application practice needs, and students cannot participate in active learning.

In order to improve the enthusiasm of students in the course of analog circuit teaching, stimulate their interest and potential in learning, enable students to integrate the knowledge of each chapter, and improve students' practical ability, this article proposes an analog circuit teaching method based on classic

application circuit analysis. By comparing the quantitative indicators of students' learning outcomes after traditional teaching and improved teaching methods, it can be seen that the teaching method has achieved better results.

2. Teaching method based on analysis of classic application circuits

The teaching method based on the analysis of classic application circuits has higher requirements for teachers. Teachers need to select and explain the classic circuits that fit the content of the textbook and related to practical applications, guide students to read circuit diagram, draw circuit diagram, and record circuit diagram to lay a good foundation and enable students to further understand the circuits through experiments, so that students can learn analog circuit courses well and make innovations in practical applications.

2.1 Select classic application circuits as teaching materials

The teaching materials of analog circuit course are often arranged separately according to the content of diodes, transistors, operational amplifiers, etc. Teachers generally teach theoretically in accordance with the order of chapters. After finishing teaching a chapter, teachers will test or assign homework for the content of the chapter. Therefore, when students encounter practical applications, such as participating in some electronic design competitions, they feel that they have not learned much of the practical content in the analog circuit course, and they are confused when they encounter the debugging of actual circuit. In fact, the analog electronic technology course is a combination of theory and practice. It cannot be mastered in depth by relying on textbooks alone. If some key circuits in practical applications are selected for explanation, students can link the knowledge of each chapter. It is easier to integrate theory with practice, and to encourage students to stimulate their own innovative thinking based on learning and understanding.

Teachers need to keep up with the times and collect some application analog circuits as teaching materials which can be from internet, journals or books. By selecting classic electronic circuit design cases from these materials, teachers can combine different teaching contents and chapters of the textbook to carry out teaching.

According to the teaching content of analog circuit course and practical application, the teaching materials can be collected and organized roughly through the following five basic categories: 1), separate component design circuit; 2), analog integrated chip design circuit; 3), digital logic chip design circuit; 4), separate integrated hybrid design circuit; 5), single-chip hybrid design circuit.

In order to meet the teaching requirements, the classic circuit can be selected according to the following ideas:

- 1) The selected circuit is a comprehensive application of the content of all or part of the units in the textbook;
- 2) The selected circuit has innovative design;
- 3) The selected circuit has strong applicability,
- 4) The selected circuit is highly inspirational.

Figure 1 is a classic analog integrated chip circuit case collected based on the above ideas. The circuit

is simple and clear, but the knowledge points covered are very rich, closely linked to multiple teaching points in the book. The realization and debugging of this circuit are very simple, and the practical application is extensive. Through this case, the students can further move from "theoretical circuit and ideal circuit" to the design and application of "application circuit".

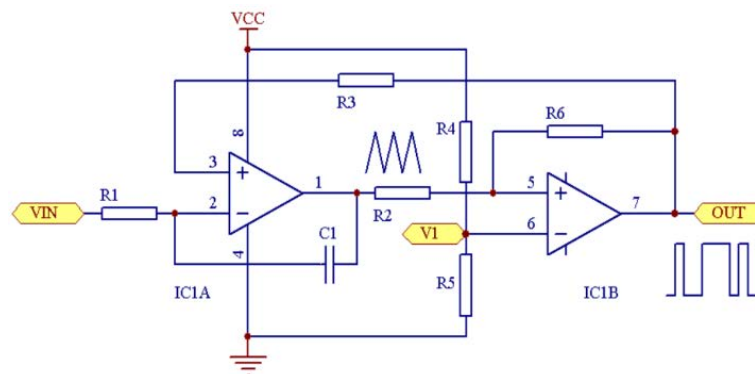


Figure 1. A voltage-controlled PWM pulse width modulation circuit designed by a classic operational amplifier

The reasons for choosing this case circuit are detailed below.

1) First of all, a basic combination design concept can be established through an ideal operational amplifier. Take a typical circuit (such as $\mu A741$) as an example, it can be used for students to analyze and understand the components and working principles of the circuit, and master the important components of the multi-stage direct coupling amplifier of the differential amplifier. In addition to mastering its working principle, students should also pay attention to calculating various indicators based on "Ideal circuit". For the internal units of the new circuit, teachers can give a focused introduction and indicate the direction of development. Emphasis is placed on the main technical indicators, functional meanings and application scenarios, so that the correct model can be selected when designing the circuit.

2) Through application circuit case analysis, teachers can focus on application circuits such as operational amplifiers, comparators, integrators, pulse width modulators, triangle wave generators, square wave generators, etc. Introducing the actual design circuit leads to more knowledge concepts of the analog circuit course.

2.2 Impression-enhancing teaching

Most of the analog circuit course teaching decomposes the circuit into the smallest unit or equivalent circuit for teaching and involving many theoretical derivations, which is lack of enlightenment. It ignores the practical working principle under the complete circuit. The teaching method of "Reading, Drawing and Memorizing circuit diagram" can help students deepen their understanding and memory, and facilitate practical application in the future. To read the circuit diagram is to understand the ins and outs of circuit design in detail; to draw circuit diagram is to practice hands, eyes, and brains; to memorize circuit diagram is to remember some commonly used circuits so that they can be quickly used when developing and designing projects application. By carrying out impression-enhancing teaching by reading, drawing and memorizing circuit diagram, students can be familiar with circuits and principle derivation.

1) How to read the circuit diagram? To understand the circuit diagram is to grasp the working principle and working process of the circuit. So reading circuit diagrams is actually an essential part of the process of learning circuit principles. The circuit diagram needs to follow the design concept of the circuit, according to the circuit principle, according to the work flow, according to the circuit structure, according to the circuit layout, according to the circuit type, from input to output, from power supply to load.

2) How to draw circuit diagrams? There are generally two ways, one is manual drawing, and the other is software drawing. Due to the large amount of teaching and learning, the drawing of circuit diagrams is basically handed over to the computer software to complete, and student learning by drawing circuit diagrams by hand is discarded. Lack of using hands and brains in circuit learning will result in the lack of deep understanding and memory of circuit diagrams in analog circuit learning, and even some students forget the circuits they have just learned. In fact, manual drawing is still very important in the study of analog circuits. In the future, the basic skills will become very important when solving practical problems on the spot in the work.

3) How to memorize circuit diagrams? The process of drawing diagrams is equivalent to enhancing memory. The purpose of memorizing circuit diagrams is to be able to apply them flexibly in the process of learning and practice, and to establish students' own circuit diagram memory bank, which can be remembered in the future, either to use the circuit or to design a new circuit based on the circuit.

Take Figure 1 as an example to illustrate the importance of "Reading, Drawing and Memorizing circuit diagram". It can be seen that this circuit is composed of two operational amplifier units IC1A and IC2B integrated circuits (represented by block diagram symbols). The first part is composed of operational amplifier IC1A to form an integral circuit. The RC forms a time constant network and the feedback capacitor achieves voltage-controlled integration to generate a fixed-frequency triangular wave output. The second part is a Schmitt trigger, or comparison trigger, composed of an operational amplifier IC2B. The comparison threshold voltage V_1 is set by R_4/R_5 , and a square wave oscillator is formed by the second-stage output and R_3 feedback. It can be seen that reading, drawing, memorizing and analysis of this case bring students into the core knowledge of the textbook, deepen the understanding of the principle of operational amplifier, integrator, RC time constant network, comparator, Schmitt trigger, triangle wave, square wave and PWM modulation circuit. This is our true teaching purpose.

2.3 Classic circuit analysis and hands-on implementation

In traditional analog circuit teaching, when students study a complete course, they often still feel a mess. They don't have a complete concept in their minds. They cannot integrate what they have learned and form a solid knowledge store.

Therefore, in the teaching process, we provide students with a classic circuit and application scenario from the beginning, so that students have an overall impression, and then use our previous teaching methods combined with the theoretical knowledge of textbooks to guide learning, which can enable students to better understand and analyze the key and difficult points in analog circuit learning, and enhance students' interest in learning and the ability to comprehensively apply basic knowledge, thereby improving the quality of analog circuit teaching.

In the PWM modulation circuit designed by the operational amplifier in Figure 1, through a simple

circuit analysis, it is not difficult to understand that IC1 is connected to a voltage-controlled integrator circuit, and the voltage control at the input terminal determines the integral charging rate of capacitor C1. IC2 constitutes a Schmitt trigger. The comparator circuit compares and outputs by setting the comparison voltage and the input voltage. Two-stage op amp cascade feedback to realize a typical analog PWM pulse width modulation circuit, if IC2B output is low, the output voltage of IC1A gradually drops to below the threshold voltage V1, then the output of IC2B becomes High level, at the same time, the output level of the integrator is increased by feedback R6 until it reaches the upper limit of the threshold, and the output becomes high immediately. Changing the input voltage of the inverting input terminal of IC1 can change the characteristics of the integrator. Because the threshold voltage V1 is fixed, the output pulse repetition period has changed, and the square wave change value can achieve a 0-100% change, but the frequency remains constant.

After basic analysis of the classic application circuit, teachers can put relevant reference materials on the online learning platform of this course, so that students can think about the circuit in detail after class, and use the devices and experimental platform provided by the university to carry out the circuit.

Practical courses should carry out practical activities, teaching guidance and practical guidance according to the aspects of students' interest-oriented, application-oriented, behavior-oriented, demand-oriented, and ability-oriented based on the classic circuit learning. Practical activities can be carried out independently in time and subject.

3. Practical application results of this teaching method

The analog circuit course of our university starts in the third semester, and majors in automation, measurement and control (MC), and electronic information engineering (EE) will start at the same time. The major of measurement and control is selected as a teaching reform pilot, while other majors are temporarily taught by traditional methods. Extracurricular learning and reference materials are uploaded on the university's online teaching platform, which is open to students in all classes as SPOC (Small Private Online Course). After a semester of study, the learning dynamics and results of a class of measurement and control major (38 students in total) and a class of electronic information engineering major (40 students in total) were compared. The results are as follows.

3.1 Comparison of student learning activity

The analog electronic technology course has a total of 56 class hours, 4 class hours per week, and a total of 14 weeks. The number of independent learning by students on the school's online education platform per week is used as a quantitative indicator of learning activity. Then in the fall semester of 2019, the data given by the university's online teaching platform is shown in Figure 2. The results show that the students of the measurement and control major are more active in learning, indicating that this teaching method uses classic application circuits as examples, and connects various knowledge points through analytical circuits to make it easier for students to understand; through the early stage of reading, drawing, and memorizing circuit diagram for students, the exercise enables students to lay a good foundation and can independently think about the principle details of classic application circuits under the inspiration of

teachers. After class, they can further analyze and calculate related indicators of circuits by consulting the reference materials provided by teachers on the online platform. The realization of the classic application circuits improves students' enthusiasm and autonomy in learning. And in the later stage, when the application circuit cases provided by the teacher are more complex and comprehensive, the number of students' autonomous learning increases significantly, which reflects the students' re-learning of the previous content to a certain extent, and this is conducive to the students' understanding of complex circuits. From the figure, it also can be found that in 5 weeks, the study times of the students majoring in electronic information engineering is less than the number of students in this class, indicating that some students in the class who usually have poor self-learning ability do not want to invest time after class. The average study times of EE students is 47% lower than MC students. This shows that using the traditional teaching method to explain the principles in the order of chapters, the process of passive reception by students is poor in mobilizing students' learning enthusiasm; although some basic reference materials are provided, teachers' guidance is lacking and students' basic skills are not solid, so they are not motivated to learn independently.

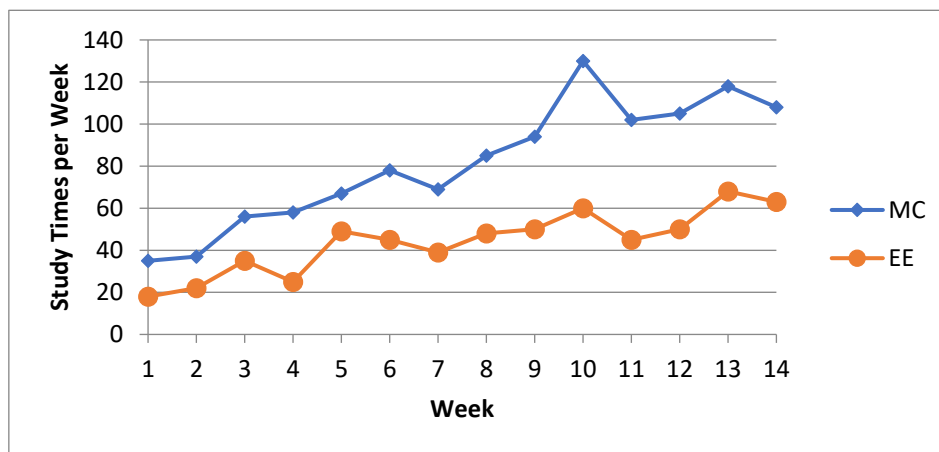


Figure 2. Comparison of learning activities of the students majoring in measurement control and electronic information engineering.

3.2 Comparison of student performance

The final exams of the two classes use a unified written test paper for closed-book examinations, with a total score of 100 points. The test results of the two classes are shown in Figure 3. As shown in the figure, the failure (with a score of less than 60) rate of the MC students (4.5%) is lower than that of EE students (8.2%); the excellent (90-100 points) rate (9.2%) of the MC students is higher than that of the EE students (4.6%); for the proportion of the population with good results in the 80-89 subarea, the MC major is higher than the EE major; and for the middle level (70-79 points) range, the proportion of students of the two majors are basically the same. After implementing the teaching method based on classical application circuit analysis, due to the improvement of students' learning initiative, enthusiasm and practical ability, the final grades of students of measurement and control are better than those of electronic information engineering who have not implemented this teaching method.

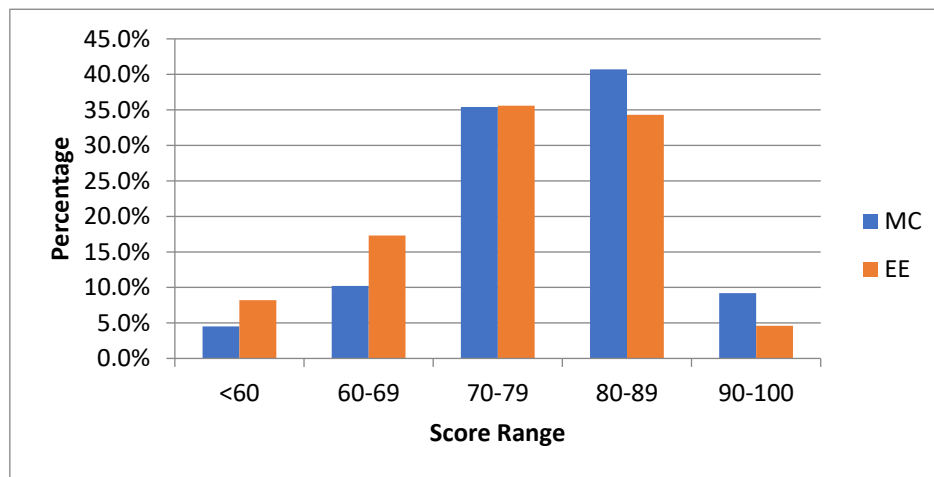


Figure 3. Comparison of test performance of the students majoring in measurement control and electronic information engineering.

4. Conclusion

The analog circuit course is a professional basic course for electrical and related majors. This course has the characteristics of combining theory and practice. It is a professional basic course for learning basic analog electronic devices, electronic circuits and electronic system analysis and design. The teaching method based on the analysis of classic application circuits proposed in this paper emphasizes the learning, consolidation and expansion of students' basic knowledge. First, carefully select the application circuits that cover the important knowledge points of the textbook, and then teach students to read, draw, and memorize the circuit diagram, so that students can deeply understand the application circuit and form a deep impression, which is convenient for designing actual electronic systems for direct use or innovation on this basis. Since the selected circuits have specific application backgrounds, students have specific goals and enthusiasm for self-study/review and hands-on realization after class, which is very important for learning analog circuits well. Through the comparison of learning activity and academic performance between the class that implements the teaching method and the class that does not implement the teaching method, it is found that the learning effect of the class that implements the teaching method is better than that of the non-implemented class.

5. References

1. Dogan Ibrahim. A New Approach for Teaching Microcontroller Courses to Undergraduate Students. *Procedia - Social and Behavioral Sciences*, 2014, 131: 411-414.
2. Harun Chowdhury, Firoz Alam, Israt Mustary. Development of an innovative technique for teaching and learning of laboratory experiments for engineering courses. *Energy Procedia*, 2019, 160: 806-811.
3. Junbo Chen, Hui Zhou, Dandan Yang, Huimin Cao. Exploration on the Teaching Reform of "Analog Electronic Technology" under the Background of New Engineering. *Journal of Electrical & Electronic*

Education, 2020, 42(03):41-44+48.

4. Jing Chen, Xuefei Shi. Teaching Reform and Practice of "Analog Electronic Technology" Course. Higher Education of Sciences, 2020, (03): 119-123.

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/>).

Screening for antiviral activity of two purified saponin fractions of *Quillaja* spp. against Yellow Fever Virus and Chikungunya Virus

Eduardo Artur Troian^{1a}, Karoline Schallenberger^{1a}, Francini Pereira da Silva^a, Gabriela Klein Dietrich^b, Fernando Ferreira Chiesa^c, Cristina Olivaro^e, Federico Wallace^e, Juliane Fleck^d, Simone Gasparin Verza^{a, d*}

^a Graduate Program in Virology, Feevale University, Novo Hamburgo, Rio Grande do Sul, Brazil

^b Institute of Health Sciences, Feevale University, Novo Hamburgo, Rio Grande do Sul, Brazil

^c Organic Chemistry Department, Carbohydrates and Glycoconjugates Laboratory, Udelar, Montevideo, Uruguay

^d Graduate Program in Toxicology and Analytical Toxicology, Feevale University, Novo Hamburgo, Rio Grande do Sul, Brazil

^e Espacio de Ciencia y Tecnología Química, Centro Universitario de Tacuarembó, Cenur Noreste, Udelar, Tacuarembó, Uruguay

¹ The authors worked together and contributed equally

***Corresponding author**

Simone G. Verza, PhD*

Feevale University, Campus II - 2755, RS 239

Postal code 93525-075 Novo Hamburgo, Rio Grande do Sul, Brazil

Abstract

Yellow Fever Virus (YFV) and Chikungunya Virus (CHIV) are neglected reemerging pathogens that cause comorbidities worldwide. Since no antiviral drug is prescribed for those infections, there is a demand on researching compounds that inhibit viral replication. Saponins are amphiphilic compounds that already demonstrated *in vitro* activity against enveloped virus. Therefore, two purified saponin fractions from *Quillaja* spp. were evaluated regarding their antiviral potential against YFV and CHIKV. The cell line used in this study was VERO (African green monkey kidney cells) since it is permissive to the replication of both viruses. The antiviral activity of both saponins fractions was screened using the plaque reduction assay protocol. Although saponins did not inhibited YFV replication, they strongly inhibited CHIKV. To confirm the absence of antiviral activity of *Quillaja* saponins against YFV, the cytopathic effect inhibition assay was performed also. Further studies are required to determine the antiviral mechanisms involved in the CHIKV inhibition.

Keywords: Antiviral; *Chikungunya virus*; Quil-A®; *Quillaja brasiliensis*; saponins; *Yellow Fever virus*

1. Introduction

Blood-feeding arthropods, like mosquitoes and ticks usually carry viral agents (commonly called arboviruses) and remain as an important concern worldwide especially in tropical regions due to their prevalence [1]. *Yellow Fever Virus* and *Chikungunya* virus are remerging neglected pathogens that have the potential to cause epidemics [2]. Although these infections tend to be self-limited, they often leave sequelae that can last for years [2].

The *Yellow Fever Virus* (YFV) was the first viral disease described for humans in 1927. It is a 40 nanometers single-stranded RNA enveloped virus belonging to the *Flaviviridae* family genus *Flavivirus* [3–7]. Clinical manifestations are variable, and the infection can occur asymptomatic or in severe forms, as individuals can undergo spontaneous cure or hemorrhagic shock [8–10]. Even with the immunization, yellow fever (YF) causes recurring outbreaks with devastating outcomes specially in South America and Africa [5,11].

The Chikungunya Virus (CHIKV) is a member of the *Togaviridae* family genus *Alphavirus* first described in 1952. It is an enveloped virus, and its genome consists of a single-strand positive RNA [12]. A typical clinical symptom is the immobilizing arthralgia that usually have long-term sequelae, mostly because the virus can create a reservoir and evade the immune response. There is no immunization for this infection and the treatment focus on alleviating the symptoms [13,14].

For both viral infections there is no specific antiviral treatment approved [7]. Therefore, the increase in the number of cases associated with the comorbidities caused by these infections suggests the search for molecules with specific activity against these viruses [15]. In this context, saponins are being studied regarding their antiviral properties against enveloped and non-enveloped virus [16]. They consist of a natural occurring glycosides found in a diversity of plants, small crustaceans and some bacteria [17,18]. Because of its amphiphilic structure, they easily interact with cholesterol and phospholipids, leading to morphological changes in cell membranes, triggering different biological activities, including antimicrobial [18]. Quil-A® is a commercially available purified fraction obtained from *Quillaja saponaria* and is widely studied, to which many antimicrobial activities are reported, including antiviral [16,19]. A concern regarding the use of *Q. saponaria* saponins refers to plant depredation since the barks are rich in saponins. In this context, alternative renewable sources are of major importance. Special attention has been paid to the congener specie *Quillaja brasiliensis* since the highest content of saponins are found in the leaves [20,21], which decreases depredation. A purified fraction named Fraction B (FB) demonstrated similar constitution to *Q. saponaria* [22], and it can be inferred that they share similar biological properties. It is well established the obtaining method for Quil-A® as it is a commercial product. On the other hand, FB is obtained by solid phase extraction of the aqueous extracts of *Q. brasiliensis* and characterized as previously described [22]. Although previous reports demonstrated antiviral activity for *Q. saponaria* [19,23], no data is described regarding its activity against arboviruses. Therefore, for the first time, we report the *in vitro* antiviral activity of a Quil-A® and FB against YFV and CHIKV.

2. Material and Methods

2.1 Cells and Viruses

VERO cells were grown on Eagle's Minimum Essential Medium (MEM, Sigma-Aldrich, USA) supplemented with 10% Fetal Bovine Serum (FBS) (Cultilab, Brazil) and maintained at 37°C in humid atmosphere with 5% CO₂. *Yellow fever virus* 17D and CHIKV were kindly given by Dr. Laura Helena (Fiocruz, Brazil), propagated and titrated in VERO cells.

2.2 Saponin Fractions

Quil-A® was purchased from Brentag Biosector (Frederikssund, Denmark). Fraction B (FB) was kindly given by Dr. Fernando Chiesa (Universidad de la República de Uruguay, Uruguay) and obtained as previously described [22]. Both saponin fractions were resuspended in MEM and filtered using 0.22 µm polyethersulfone membrane syringe filter (Millipore, USA). Once filtered, saponin fractions were stored in -80°C ultrafreezer.

2.3 Cell Viability Assay

Cell viability was measured by mitochondrial activity using MTT (Thiazolyltetrazolium bromide, Sigma-Aldrich, USA) assay as described by Mosmann [24] and Fotakis and Timbrell [25]. Briefly, 1.5×10^5 VERO cells were plated and incubated for 24 hours without FBS. Then, cells were treated with solutions of Quil-A® or FB starting at 25 µg/mL and incubated for 24, 48 and 120 hours, referring to acute and prolonged exposition, respectively. After incubation, compounds were removed and an MTT solution (1 mg/mL) was added and left incubating for 30 minutes. Then, the overlay was removed and Dimethyl sulfoxide (DMSO- Sigma-Aldrich, USA) added. The plate was read using SpectraMax M3 microplate reader (Molecular Devices, USA) at 570 nm and the results expressed as percentage of viable cells compared to untreated control. The concentrations that reduced 50% of cell viability (CC₅₀) were determined using non-linear logistic regression model. The percentages refer to the average of three independent experiments.

2.4 Plaque reduction assay

The plaque assays were performed as previously described [26] with some modifications. Briefly, VERO cells were plated and incubated for 24 hours. Then, the plates were infected with 100 PFU/mL at 37°C with humid atmosphere with 5% CO₂. For YFV, after 2 hours of viral adsorption, a 1:1 (v/v) solution of 1.5% carboxymethylcellulose (CMC) diluted in high glucose Dulbecco's Modified Eagle's Medium (DMEM), supplemented with 2% penicillin/streptomycin and 20 % FBS, was added. Two wells were reserved as negative control (without virus or saponins), two as viral control (without saponins) and two as cytotoxicity control, which received supplemented CMC with the highest saponins concentration (5µg/mL) tested in the experiment. The other wells were treated with serial solutions of FB or Quil-A® in duplicate. For CHIKV, the adsorption time was 1 hour, and the CMC solution consisted of a 1:1 (v/v) solution of 3% CMC with MEM without FBS and antibiotics.

Lysis plaques were counted using a magnifying glass, and the percentage of inhibition of viral

replication was calculated according to the formula: (mean number of plaques counted in each concentration tested / number of plaques in viral control) x 100.

2.5 Cytopathic effect inhibition assay

The cytopathic effect inhibition assay (CEI) was conducted as previously described [27] with adaptations. A 96-well plate was prepared with VERO cells at a concentration of 1.5×10^5 cells/mL and incubated for 24 hours at 37 ° C with 5% CO₂ atmosphere. Then, 1:10 serial dilutions of the viral suspension were added, and the plate incubated for two hours. After incubation, the overlay was removed and added MEM to the first four columns, reserved for viral titration. The last four columns were treated with a single concentration of the saponins (5 µg/mL). The two central columns were reserved as negative control, to which the last four wells were used as cytotoxicity control and were also treated. The microplate was incubated for five days for viral replication. The reading was performed using inverted microscope and the titer determined using the Spearman & Kärber method [28].

3. Results and Discussion

Two purified saponins fractions were screened to access their cytotoxicity. For the acute exposition, the cytotoxic concentration for 50% of the cells (CC₅₀) were 18.1 and 25 µg/mL respectively. Then, the cells were exposed to 48 and 120 hours, referring to CHIKV and YFV replication times. Quil-A® was more toxic than FB at all exposure times (Table 1).

Table 1. Cytotoxicity of Quil-A® and FB.

	Quil-A® CC ₅₀ (µg/mL)	FB CC ₅₀ (µg/mL)
Acute (24 hs)	18.11	25.05
48 hours	10.85	14.68
120 hours	9.27	13.1

Cytotoxicity is the crucial factor that determines whether a molecule will be tested for its biological properties. Molecules which exhibit activity at toxic concentrations are not feasible for use in commercial formulations and therefore are discarded or undergo structural changes in order to reduce toxicity [29]. Because of the amphiphilic structure of the saponins, they have affinity with cell membranes. *Q. saponaria* and *Q. brasiliensis* features an aldehyde side chain at carbon 4 (Figure 1), which interacts with free amino acids and membrane proteins, causing changes in the cells which generally lead to loss of cell viability [30,31]. It is hypothesized that highly cytotoxic saponins easily interact with cholesterol and phospholipids, recruiting them from the membrane and redistributing as they are solubilized, causing membranolytic activity. On the other hand, less hemolytic saponins interact with cholesterol in order to alter their distribution without removing them from the membrane, resulting in morphological changes in cell structure, therefore triggering toxicity [32,33].

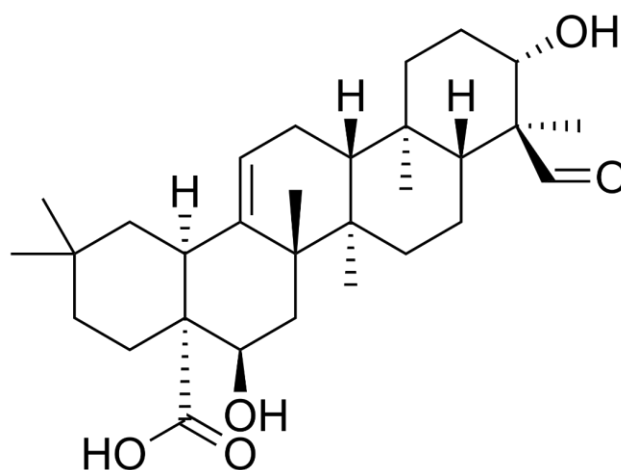


Figure 1. Quillaic acid structure, a common aglycone in both Quil-A® and FB.

Quil-A® and another purified saponins fraction from *Q. brasiliensis* named QB-90 were previously evaluated regarding their toxicity *in vitro* using VERO cells. It was found that 50 µg/mL of Quil-A® resulted in less than 20% of cell viability after 48 hours of exposure, while QB-90 resulted in more than 90%. The same was observed concerning the hemolytic activity, since QB-90 was significantly less hemolytic [34]. The higher toxicity of FB compared to QB-90 may be related to differences in their composition of saponins. Previous studies demonstrated that FB have similar composition to Quil-A®, and therefore similar toxicity properties can be observed between these two fractions [22]. Because of this affinity with cell membrane, saponins are interesting antiviral candidates, since they can interact with viral envelope or capsid, or with an infected cell [23,35].

Using a nontoxic concentration of *Quillaja* saponins, no antiviral activity was observed for the YFV (Table 2). Even with inhibition percentiles of 75.2% and 36.8% for Quil-A® and FB, respectively, these data suggest that both fractions are not antiviral, since a good candidate should inhibit about 95% of replication [36].

Table 2. Antiviral properties of both saponins' fractions, expressed as the percentage of inhibition of viral replication.

	Percentage of YFV inhibition		Percentage of CHIKV inhibition	
	Quil-A®	FB	Quil-A®	FB
5 µg/mL	75.26	36.8	100	93
2.5 µg/mL	66	50	32	24.9
1.25 µg/mL	27.8	40.8	7.9	19.3

To confirm the lack of antiviral activity, we used CEI assay to determine whether a single concentration of the tested compounds could inhibit viral replication. At a concentration of 5 µg/mL, the viral titer (number of viral particles) did not change (Table 3), indicating that both FB and Quil-A® are not antiviral agents for YFV.

Table3: YFV viral titer during the Cytopathic effect inhibition assay in VERO cells

	With Antiviral treatment	Without Antiviral treatment
FB (5µg/mL)	2.47x10 ⁶	4.39x10 ⁶
Quil-A® (5µg/mL)	7.83x10 ⁶	1.65x10 ⁶

Both saponins fractions were evaluated against CHIKV, another emerging arbovirus that caused an outbreak in Latin America back in 2014 [37]. In contrast to YFV results, *Quillaja* saponins have been shown to be quite effective in blocking viral replication. Quil-A® reduced the number of lysis plaques by 100%, while FB reduced 93% (Table 2).

Previous reports demonstrated antiviral activity for *Q. saponaria* aqueous extracts against non-enveloped [19,35] and enveloped viruses [7,38,39]. It is known that saponins can inhibit replication by degrading enzymes or lysing replicating sites, by directly degrading viral envelope or capsid and by causing modifications in cell morphology, blocking the infection [23,35,40].

Flavivirus replication is similar to *Alphavirus*, as the biggest difference resides in the fact that *Flavivirus* viral assembly occurs in the endoplasmic reticulum and maturation in the Golgi apparatus, while for *Alphavirus* it occurs in cytoplasm and it matures as the virion buds to plasma membrane [41–44]. These differences could be related with not inhibition YFV by *Quillaja* saponins.

It is known that the *Flaviviridae* family have some miRNA transcripts responsible ‘helping’ transcription process. Interestingly, there is evidence that when an exogenous signal that may impair the replication process is recognized, some miRNA interfere, inducing the virus to evade the antiviral response [45–47]. Although we did not investigate the molecular mechanisms, this might be one of the reasons why saponins could not inhibit viral replication of YFV.

4. Conclusion

This study reports the antiviral properties of two *Quillaja* spp. purified fractions against the YFV and CHIKV. Although no antiviral activity was observed for YFV, Quil-A® and FB strongly inhibited CHIKV replication, *in vitro*. The antiviral activity of *Quillaja* saponins against CHIKV was first reported in this work and reinforce the current data about antiviral properties *Quillaja* saponins against enveloped and non-enveloped viruses. Further investigations are required to better understand the antiviral mechanism.

5. Acknowledgement

The authors would like to thank CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) and University Feevale for the financial support.

6. References

- [1] A.J. Wilson, L.E. Harrup, Reproducibility and relevance in insect-arbovirus infection studies, Curr. Opin. Insect Sci. 28 (2018) 105–112. <https://doi.org/10.1016/j.cois.2018.05.007>.

- [2] A. Wilder-Smith, D.J. Gubler, S.C. Weaver, T.P. Monath, D.L. Heymann, T.W. Scott, Epidemic arboviral diseases: priorities for research and public health, *Lancet Infect. Dis.* 17 (2017) e101–e106. [https://doi.org/10.1016/S1473-3099\(16\)30518-7](https://doi.org/10.1016/S1473-3099(16)30518-7).
- [3] J.E. Staples, Yellow Fever: 100 Years of Discovery, *JAMA.* 300 (2008) 960. <https://doi.org/10.1001/jama.300.8.960>.
- [4] P.J. Bredenbeek, E.A. Kooi, B. Lindenbach, N. Huijckman, C.M. Rice, W.J.M. Spaan, A stable full-length yellow fever virus cDNA clone and the role of conserved RNA elements in flavivirus replication, *J. Gen. Virol.* 84 (2003) 1261–1268. <https://doi.org/10.1099/vir.0.18860-0>.
- [5] T.R. Jorge, A.L.P. Mosimann, L. de Noronha, A. Maron, C.N. Duarte dos Santos, Isolation and characterization of a Brazilian strain of yellow fever virus from an epizootic outbreak in 2009, *Acta Trop.* 166 (2017) 114–120. <https://doi.org/10.1016/j.actatropica.2016.09.030>.
- [6] A.D.T. Barrett, Yellow fever live attenuated vaccine: A very successful live attenuated vaccine but still we have problems controlling the disease, *Vaccine.* 35 (2017) 5951–5955. <https://doi.org/10.1016/j.vaccine.2017.03.032>.
- [7] C.C. Pacca, R.E. Marques, J.W.P. Espindola, G.B.O.O. Filho, A.C.L. Leite, M.M. Teixeira, M.L. Nogueira, Thiosemicarbazones and Phthalyl-Thiazoles compounds exert antiviral activity against yellow fever virus and Saint Louis encephalitis virus, *Biomed. Pharmacother.* 87 (2017) 381–387. <https://doi.org/10.1016/j.biopha.2016.12.112>.
- [8] T.P. Monath, Yellow fever: An update, *Lancet Infect. Dis.* 1 (2001) 11–20. [https://doi.org/10.1016/S1473-3099\(01\)00016-0](https://doi.org/10.1016/S1473-3099(01)00016-0).
- [9] T.P. Monath, A.D.T. Barrett, Pathogenesis and Pathophysiology of Yellow Fever, *Adv. Virus Res.* 60 (2003) 343–395. [https://doi.org/10.1016/S0065-3527\(03\)60009-6](https://doi.org/10.1016/S0065-3527(03)60009-6).
- [10] C.L. Gardner, K.D. Ryman, Yellow fever: A reemerging threat, *Clin. Lab. Med.* 30 (2010) 237–260. <https://doi.org/10.1016/j.cll.2010.01.001>.
- [11] M.M. Gómez, F.V.S. de Abreu, A.A.C. dos Santos, I.S. de Mello, M.P. Santos, I.P. Ribeiro, A. Ferreira-de-Brito, R.M. de Miranda, M.G. de Castro, M.S. Ribeiro, R. da C. Laterrière Junior, S.F. Aguiar, G.L.S. Meira, D. Antunes, P.H.M. Torres, D. Mir, A.C.P. Vicente, A.C.R. Guimarães, E.R. Caffarena, G. Bello, R. Lourenço-de-Oliveira, M.C. Bonaldo, Genomic and structural features of the yellow fever virus from the 2016–2017 Brazilian outbreak, *J. Gen. Virol.* (2018). <https://doi.org/10.1099/jgv.0.001033>.
- [12] J.A. González-Sánchez, G.F. Ramírez-Arroyo, Chikungunya Virus: History, Geographic Distribution, Clinical Picture, and Treatment., *P. R. Health Sci. J.* 37 (2018) 187–194. <https://doi.org/10.1089/ast.2015.1406>.
- [13] M.K. Huntington, J.A.Y. Allison, D. Nair, *Emerging Vector-Borne Diseases*, (2016).
- [14] R. Abdelnabi, D. Jochmans, E. Verbeken, J. Neyts, L. Delang, M.K. Huntington, J.A.Y. Allison, D. Nair, Antiviral treatment efficiently inhibits chikungunya virus infection in the joints of mice during the acute but not during the chronic phase of the infection, *Antiviral Res.* 149 (2018) 113–117. <https://doi.org/10.1016/j.antiviral.2017.09.016>.
- [15] J.D. Beckham, K.L. Tyler, Arbovirus Infections, *Contin. Lifelong Learn. Neurol.* 21 (2015) 1599–1611. <https://doi.org/10.1212/CON.0000000000000240>.

- [16] J.D. Fleck, A.H. Betti, F. Pereira da Silva, E.A. Troian, C. Olivaro, F. Ferreira, S.G. Verza, Saponins from *Quillaja saponaria* and *Quillaja brasiliensis*: Particular chemical characteristics and biological activities, *Molecules*. 24 (2019). <https://doi.org/10.3390/molecules24010171>.
- [17] Ö. Guclu-Ustundag, G. Mazza, Saponins: Properties, applications and processing, *Crit. Rev. Food Sci. Nutr.* 47 (2007) 231–258. <https://doi.org/10.1080/10408390600698197>.
- [18] A. de Paula Barbosa, Saponins as immunoadjuvant agent: A review, *African J. Pharm. Pharmacol.* 8 (2014) 1049–1057. <https://doi.org/10.5897/AJPP2014.4136>.
- [19] M.R. Roner, J. Sprayberry, M. Spinks, S. Dhanji, Antiviral activity obtained from aqueous extracts of the Chilean soapbark tree (*Quillaja saponaria* Molina), *J. Gen. Virol.* 88 (2007) 275–285. <https://doi.org/10.1099/vir.0.82321-0>.
- [20] F. De Costa, A.C.A. Yendo, S.P. Cibulski, J.D. Fleck, P.M. Roche, F.R. Spilki, G. Gosmann, A.G. Fett-Neto, Alternative inactivated poliovirus vaccines adjuvanted with *Quillaja brasiliensis* or *Quil-A* saponins are equally effective in inducing specific immune responses, *PLoS One*. 9 (2014) 1–7. <https://doi.org/10.1371/journal.pone.0105374>.
- [21] A.C.A. Yendo, F. De Costa, J.D. Fleck, G. Gosmann, A.G. Fett-Neto, Irradiance-based treatments of *Quillaja brasiliensis* leaves (A. St.-Hil. & Tul.) Mart. as means to improve immunoadjuvant saponin yield, *Ind. Crops Prod.* 74 (2015) 228–233. <https://doi.org/10.1016/j.indcrop.2015.04.052>.
- [22] F. Wallace, Z. Bennadji, F. Ferreira, C. Olivaro, Analysis of an immunoadjuvant saponin fraction from *Quillaja brasiliensis* leaves by electrospray ionization ion trap multiple-stage mass spectrometry, *Phytochem. Lett.* 20 (2017) 228–233. <https://doi.org/10.1016/j.phytol.2017.04.020>.
- [23] M.R. Roner, K.I. Tam, M. Kiesling-Barrager, Prevention of rotavirus infections in vitro with aqueous extracts of *Quillaja Saponaria* Molina, *Future Med. Chem.* 2 (2010) 1083–1097. <https://doi.org/10.4155/fmc.10.206>.
- [24] T. Mosmann, Rapid colorimetric assay for cellular growth and survival: Application to proliferation and cytotoxicity assays, *J. Immunol. Methods*. 65 (1983) 55–63. [https://doi.org/10.1016/0022-1759\(83\)90303-4](https://doi.org/10.1016/0022-1759(83)90303-4).
- [25] G. Fotakis, J.A. Timbrell, In vitro cytotoxicity assays: Comparison of LDH, neutral red, MTT and protein assay in hepatoma cell lines following exposure to cadmium chloride, *Toxicol. Lett.* 160 (2006) 171–177. <https://doi.org/10.1016/j.toxlet.2005.07.001>.
- [26] F.G. Burleson, T.M. Chambers, D.L. Wiedbrauk, F.G. 16 – Plaque assays, in: *Virology*, 1992: pp. 74–84. <https://doi.org/10.1016/B978-0-12-144730-4.50019-9>.
- [27] F.G. Burleson, T.M. Chambers, D.L. Wiedbrauk, F.G. 12 – TCID₅₀, in: *Virology*, 1992: pp. 58–61. <https://doi.org/10.1016/B978-0-12-144730-4.50015-1>.
- [28] M.A. Ramakrishnan, Determination of 50% endpoint titer using a simple formula, *World J. Virol.* 5 (2016) 85. <https://doi.org/10.5501/wjv.v5.i2.85>.
- [29] W. Li, J. Zhou, Y. Xu, Study of the in vitro cytotoxicity testing of medical devices, *Biomed. Reports*. 3 (2015) 617–620. <https://doi.org/10.3892/br.2015.481>.
- [30] S. Böttcher, S. Drusch, Saponins — Self-assembly and behavior at aqueous interfaces, *Adv. Colloid Interface Sci.* 243 (2017) 105–113. <https://doi.org/10.1016/j.cis.2017.02.008>.
- [31] D.J. Marciani, Elucidating the Mechanisms of Action of Saponin-Derived Adjuvants, *Trends*

- Pharmacol. Sci. 39 (2018) 573–585. <https://doi.org/10.1016/j.tips.2018.03.005>.
- [32] K. Wojciechowski, M. Orczyk, T. Gutberlet, T. Geue, Complexation of phospholipids and cholesterol by triterpenic saponins in bulk and in monolayers, *Biochim. Biophys. Acta - Biomembr.* 1858 (2016) 363–373. <https://doi.org/10.1016/j.bbamem.2015.12.001>.
- [33] C.L. Reichert, H. Salminen, G. Badolato Bönisch, C. Schäfer, J. Weiss, Concentration effect of Quillaja saponin – Co-surfactant mixtures on emulsifying properties, *J. Colloid Interface Sci.* 519 (2018) 71–80. <https://doi.org/10.1016/j.jcis.2018.01.105>.
- [34] F. Silveira, S.P. Cibulski, A.P. Varela, J.M. Marqués, A. Chabalgoity, F. de Costa, A.C.A. Yendo, G. Gosmann, P.M. Roehle, C. Fernández, F. Ferreira, Quillaja brasiliensis saponins are less toxic than Quil A and have similar properties when used as an adjuvant for a viral antigen preparation, *Vaccine.* 29 (2011) 9177–9182. <https://doi.org/10.1016/j.vaccine.2011.09.137>.
- [35] K.I. Tam, M.R. Roner, Characterization of in vivo anti-rotavirus activities of saponin extracts from Quillaja saponaria Molina, *Antiviral Res.* 90 (2011) 231–241. <https://doi.org/10.1016/j.antiviral.2011.04.004>.
- [36] F.G. Burleson, T.M. Chambers, D.L. Wiedbrauk, F.G. 33 – Plaque Reduction Bioassay, in: *Virology*, 1992: pp. 152–156. <https://doi.org/10.1016/B978-0-12-144730-4.50036-9>.
- [37] J.A. Cardona-Ospina, F.A. Diaz-Quijano, A.J. Rodríguez-Morales, Burden of chikungunya in Latin American countries: Estimates of disability-adjusted life-years (DALY) lost in the 2014 epidemic, *Int. J. Infect. Dis.* 38 (2015) 60–61. <https://doi.org/10.1016/j.ijid.2015.07.015>.
- [38] Y.L. Zhao, G.M. Cai, X. Hong, L.M. Shan, X.H. Xiao, Anti-hepatitis B virus activities of triterpenoid saponin compound from *Potentilla anserina* L., *Phytomedicine.* 15 (2008) 253–258. <https://doi.org/10.1016/j.phymed.2008.01.005>.
- [39] M. Amoros, B. Fauconnier, R.L. Girre, In vitro antiviral activity of a saponin from *Anagallis arvensis*, *Primulaceae*, against herpes simplex virus and poliovirus, *Antiviral Res.* 8 (1987) 13–25. [https://doi.org/10.1016/0166-3542\(87\)90084-2](https://doi.org/10.1016/0166-3542(87)90084-2).
- [40] C.M.O. Simões, M. Amoros, L. Girre, Mechanism of antiviral activity of triterpenoid saponins, *Phyther. Res.* 13 (1999) 323–328. [https://doi.org/10.1002/\(SICI\)1099-1573\(199906\)13:4<323::AID-PTR448>3.0.CO;2-C](https://doi.org/10.1002/(SICI)1099-1573(199906)13:4<323::AID-PTR448>3.0.CO;2-C).
- [41] J. Jose, J.E. Snyder, R.J. Kuhn, A structural and functional perspective of alphavirus replication and assembly, *Future Microbiol.* 4 (2009) 837–856. <https://doi.org/10.2217/fmb.09.59>.
- [42] J. Jose, A.B. Taylor, R.J. Kuhn, Spatial and Temporal Analysis of Alphavirus Replication and Assembly in Mammalian and Mosquito Cells, *MBio.* 8 (2017) e02294-16. <https://doi.org/10.1128/mBio.02294-16>.
- [43] G. Gerold, J. Bruening, B. Weigel, T. Pietschmann, Protein interactions during the Flavivirus and hepatitis C virus life cycle, *Mol. Cell. Proteomics.* 16 (2017) S75–S91. <https://doi.org/10.1074/mcp.R116.065649>.
- [44] J.N. Conde, E.M. Silva, A.S. Barbosa, R. Mohana-Borges, The complement system in flavivirus infections, *Front. Microbiol.* 8 (2017) 1–7. <https://doi.org/10.3389/fmicb.2017.00213>.
- [45] B.L. Heiss, O.A. Maximova, A.G. Pletnev, Insertion of MicroRNA Targets into the Flavivirus Genome Alters Its Highly Neurovirulent Phenotype, *J. Virol.* 85 (2011) 1464–1472.

<https://doi.org/10.1128/jvi.02091-10>.

- [46] N.L. Teterina, O.A. Maximova, H. Kenney, G. Liu, A.G. Pletnev, MicroRNA-based control of tick-borne flavivirus neuropathogenesis: Challenges and perspectives, *Antiviral Res.* 127 (2016) 57–67. <https://doi.org/10.1016/j.antiviral.2016.01.003>.
- [47] L. Bavia, A.L.P. Mosimann, M.N. Aoki, C.N. Duarte Dos Santos, A glance at subgenomic flavivirus RNAs and microRNAs in flavivirus infections, *Virology* 13 (2016) 1–21. <https://doi.org/10.1186/s12985-016-0541-3>.

The Difference Between Environmental Costs in Mining Companies Before and After the Issuance of Indonesia Financial Accounting Standards (PPSAK) No. 12 of 2014 Concerning Soil Laying Activities and Environmental Management

Shofyan Nur Hidayat¹⁾, Lindrianasari²⁾, Rindu Rika Gamayuni³⁾

¹Faculty of Economics and Business, University of Lampung, Indonesia,
+6281271286759.shofyan634@gmail.com

²Faculty of Economics and Business, University of Lampung, Indonesia

³Faculty of Economics and Business, University of Lampung, Indonesia
Accounting Department, Faculty of Economics and Business, Lampung University.

ABSTRACT

This study aims to determine if there are differences in environmental costs in mining companies before and after the publication of Indonesian Financial Accounting Standards PPSAK No. 12 on 2014 concerning stripping activities and environmental management. The study was conducted on all mining companies listed on the Indonesian Stock Exchange, a research sample of 26 companies. Data were analyzed using Paired-samples T Test. This study shows empirical evidence that there are differences between the peeling cost and environmental management cost variables before applying PPSAK No. 12 on 2014 with the cost of peeling and environmental management costs after applying PPSAK No. 12 from 2014.

Keywords : *PPSAK 12 of 2014, Soil Stripping Activities, Environmental Management.*

INTRODUCTION

The mining sector is a sector that plays an important role in supporting national development. Mining activities are often located in river areas which are part of the environment, so that if there is no proper understanding of important aspects of environmental management, this can have negative impacts.

The scope of general mining activities based on the revised 2011 PSAK 33 regulates the Indonesian accounting treatment of peeling and environmental management activities. These two activities have a direct impact on the environment in which the mining company carries out its operational activities. With the revised version of PSAK 33 from 2011, everything can determine the extent of environmental damage and how the company is responsible for environmental management, so mining companies must disclose their information in the financial statements. of the company.

Based on PSAK 33, environmental management costs are costs allocated to prevention activities due to pollution and destruction of the environment. Accounting for General Mining PSAK 33 Revised 2011 briefly addresses two things, namely the costs that must be spent for soil stripping and the costs that must be incurred for environmental management activities to cope with the impacts that occur in the future (Pamungkas & Rusherlistyani, 2015).

The plan to revoke standards governing specific industries is unique and confusing, initially PSAK 33 governed general mining. Then, PSAK 33 underwent a change, which regulates the activity of soil stripping and environmental management. The purpose of the amendment is to abolish industrial PSAKs and only regulate matters relating to mining PSAKs that have not been specifically regulated in other PSAK. But PSAK 33 was eventually revoked with the stipulation of PPSAK No. 12 on 2014, because indirectly environmental management was regulated in PSAK 57 regarding contingency provisions and obligations. However, the activity of stripping the soil layer has not been regulated, so the related regulation is still maintained in the form of ISAK No.29 which complies with IFRS, namely IFRIC 20 Cost stripping in the production phase of an open pit mining (Martani, 2015).

The application of environmental accounting will encourage the ability to minimize the environmental problems it faces. The objective is to improve the efficiency of environmental management by evaluating environmental activities based on environmental costs and economic benefits, and to produce effects on environmental protection. This study aims to analyze whether the stipulation of PPSAK No. 12 on 2014, there are differences in environmental costs in the form of soil stripping and environmental management of mining companies.

Based on the description that has described above, so the main issues that will be empirically proven are:

1. Is there an increase in the cost of peeling the company after PPSAK No. 12 on 2014?
2. Is there an increase in the cost of environmental management in mining companies before and after the adoption of PPSAK No. 12 on 2014?

Based on the description that has described above, so the main issues that will be empirically proven are:

1. There is a difference in the cost of peeling before and after applying PPSAK No. 12 on 2014.
2. There is a difference in the cost of environmental management before and after the adoption of PPSAK No. 12 on 2014.

THEORITICAL

Signalling Theory

One way to reduce asymmetric information is to send signals to third parties, including reliable financial information that will reduce uncertainty about the future prospects of the business. With signal theory, companies provide signals to third parties. in the form of reliable financial information. and reduce uncertainty about the company's future prospects (Kusumastuti, Supatmi, & Sastra, 2008).

Financial statements should provide useful information to investors and creditors, particularly because this group is in the most uncertain conditions, which will be used to make investment, credit, and similar decisions, including cash flow statements because the cash flow statement is part of the financial statements. . In this study, signal theory will be the basis of environmental costs in mining companies before and after the stipulation of PPSAK No. 12 on 2014.

Stakeholder theory

Stakeholder theory relates to the concept of corporate responsibility where corporate responsibility is not only limited to maximizing the profits and interests of shareholders, but must also pay attention to the community, customers and suppliers in within the framework of the company's own operations. The assumptions of the stakeholder theory are based on the claim that the business becomes very large and causes the community to be very closely connected and to pay attention to the business, so the business must be responsible and responsibility more broadly and not limited to shareholders.

Mandatory information disclosure is the financial statements, this information is necessary for stakeholders who influence or are affected by the economic activities of the company. While voluntary disclosure is necessary by influential and non-influential stakeholders in the economic activities of the business. The voluntary report under development is the sustainability report. Thanks to the stipulation of PPSAK No. 12 on 2014, the company can provide more sufficient and complete information relating to soil stripping and environmental management activities.

General Mining Accounting

Since the revocation of PSAK 33, there have been a number of statements of accounting standards that relate specifically to the mining industry, including at ISAK 29, the cost of delamination is divided into two stages. The first step is the cost of peeling at the development stage. At this point, there are no specific rules. The second step is the cost of the coat at the production stage. At this point, it produces benefits in the form of inventory which is regulated in PSAK 14 and increases access through the assets of the peeling activity.

PSAK 64 exploration and evaluation of mineral resource activities, recognition of exploration and evaluation costs are recognized as exploration and evaluation assets. The measure of exploration and evaluation assets is measured at cost. In addition, you can choose the cost model or the revaluation model according to PSAK 16 (2007) or PSAK 19 (revised 2010).

PSAK 57 provisions for contingent liabilities and contingent assets, it is in this PSAK that environmental management costs are regulated after the revocation of PSAK 33 concerning general mining accounting. The cost of environmental management is regulated as a provision for environmental management.

Environmental Accounting Concepts As Corporate Environmental Responsibility

Applying environmental accounting in businesses will reduce the occurrence of environmental pollution around the business. Increase human awareness of the impact of environmental damage that will affect

survival in the future, so that the demands of society are greater. Because preserving the environment in addition to benefiting the surrounding community is also beneficial in the long term for the company.

The acculturation process takes really little time, as it has to be ready for businessmen in conventional knowledge, technology and awareness of business practices. Through the application of environmental accounting, it is expected that the environment will be preserved, because in the implementation of environmental accounting, the company will voluntarily comply with the policies of the government in which it operates. The law stipulates that each company has social and environmental responsibilities which carry out its activities in fields related to natural resources (Lindrianasari, 2007).

So far, financial reports have not been able to present information on environmental empowerment reporting activities. Environmental accounting is an attempt to link the economic interests of the company and the preservation of the environment. With the application of environmental accounting, the results of the financial statements will be holistic.

Accounting in this case, especially in environmental accounting, should be able to support the innovations brought by the company in an effort to prevent environmental pollution for business continuity. As we know, environmental accounting is part of accounting specifically capable of managing costs related to the environment. The ability of the company to implement environmental accounting as part of its activities, should be able to manage the costs related to the environment and, ultimately, the company will be able to achieve sustainable development and to support the sustainability of the business.

METHODOLOGY

Types of research

The research method is quantitative using comparative research. In this study, the researchers wanted to know if there were differences in environmental costs in the form of peeling and environmental management costs in mining companies before and after the stipulation of PPSAK No. 12 on 2014.

Population and Sample

The population of this study consists of all mining companies listed in 2012 on the Indonesian Stock Exchange (IDX). In this study, the companies in the sample were selected on the basis of reasoned sampling. The examples of criteria for this study are as follows:

1. Mining companies listed on the Indonesian Stock Exchange (IDX) from 2011 to 2018.
2. Mining companies that have not experienced delisting during the research year.
3. Mining companies that published complete financial statements during the 2011-2018 research year.

In this study, the researchers used 3 years (2012, 2013 and 2014) before the effective date of PPSAK No. 12 of 2014 and 3 years (2015, 2016 and 2017) after the effective date of PPSAK No. 12 on 2014.

Research variable

In this study, the researchers used the disclosure of mining activities costs as a 2014 PPSAK No. 12 instrument regarding stripping activities and environmental management. The scope of mining activities includes peeling and environmental management, according to PSAK 33 (revised 2011) on general mining accounts.

1. The cost of peeling the soil (BPLT), in this study, was measured by comparing the cost of peeling the soil with income, with the formula:

$$\text{BPLT} = \frac{\text{peeling costs}}{\text{Income}}$$

2. The cost of environmental management (PPLH), in this study measured by the environmental management benefit relative to income, with the formula:

$$\text{PPLH} = \frac{\text{Provision for environmental management}}{\text{Income}}$$

Data analysis method

This research will use the analysis paired sample t test. The paired sample t-test procedure is used to verify that there are no or no differences between the two variables. The data can consist of two measurements with the same subject or a measurement with several subjects.

RESULTS AND DISCUSSION

Result

Research data

Sampling using reasoned sampling, with the total number of mining companies listed on the 2012 Stock Exchange of 36 companies, then there is one company which in 2014-2018 was struck off, namely Borneo Lumbung Energi & Metal Tbk. In addition, there are 9 companies for which the author has not obtained his financial statements. So the company taken as a sample there are 26 companies.

Research result

1. Descriptive Analysis Results

Table 1
Descriptive Analysis Results

	N	Minimum	Maximum	Mean	Std. Deviation
BPLTbefore	78	,0000	,1012	,005759	,0172256
PPLHbefore	78	,0000	,8694	,025088	,1069185
BPLTafter	78	,0000	,8378	,064762	,1548439
PPLHafter	78	,0000	2,5274	,179505	,4546481
Valid N (listwise)	78				

Source: Data processed in 2020.

Variable cost of peeling (BPLTbefore) has the highest value amounted to 0.1012 and the lowest value of 0,000, and the average value of variable peeling costs (BPLTbefore) is 0.005759, with a standard deviation of 0.017256.

Variable costs for environmental management (PPLHbefore) has the highest value of 0.8694 and the lowest value of 0,000, and the average value of environmental management variable costs (PPLHbefore) is 0.025088, with a standard deviation of 0.1069.

Variable cost of peeling (BPLTafer) has the highest value of 0.8378 and the lowest value of 0,000, and the average value of the variable cost of peeling (BPLTafer) is 0.064726, with a standard deviation of 0.15484.

Variabel costs for environmental management (PPLHafer) has the highest value of 2,5274 which is owned by the company Garda Tujuh Buana Tbk with the code (GTBO) in 2016, this means the cost of environmental management is greater than the income received at the company, and the lowest value is 0,000, and the average value of environmental management variable costs (PPLHafer) is 0.14665, with a standard deviation of 0.259.

2. Test data normality

The data normality test uses the Kolmogorov-Smirnov parametric statistical test. Here are the results of the normality test:

Table 2

Normality Test Results

Variabel	Asymp. Sig. (2-tailed)
BPLTbefore	0,099
PPLHbefore	0,078
BPLTafer	0,283
PPLHafer	0,151

Source: Data processed in 2020.

It appears that the significance value of all variables is greater than the significance level of 0.05, so it can be said that the data in this study were normally distributed.

3. Hypothesis Testing Results

The first hypothesis of this study is "There is a difference in the cost of peeling before and after the application of PPSAK No. 12 of 2014". Tests carried out during the observation period 3 years before and 3 years after the application of PPSAK No. 12 of 2014, the test results are presented in the following table:

Table 3

First Hypothesis Calculation Results

Period	Average value	t-count	significance	Conclusion
BPLTbefore	0,0057	-3,3498	0.001	Ha Received
BPLTafer	0,0647			

Source: Data processed in 2020.

The calculation results show that the significance value of the calculated paired samples T test output is 0.005, the value is less than 0.05 and has a t count of -3.33498, which means that there are differences between the variable peel costs before the application of PPSAK No. 12 of 2014 with the cost of take-off after the adoption of PPSAK No. 12 of 2014, i.e. the initial assumption that states that there are differences in peel cost before and after the implementation of PPSAK No. 12 of 2014 supported.

Table 4
Second Hypothesis Calculation Results

Period	Average value	t-count	significance	Conclusion
PPLHbefore	0,025087	-3,1711	0.002	Ha Received
PPLHafter	0,179505			

Source: Data processed in 2020.

The results of the calculation show that the significance value of the calculation of the output of the T test for the paired samples is 0.002, the value is less than 0.05 and has a t count of 3.1711, which means that there are differences between the environmental management cost variables before the application of PPSAK No. 12 on 2014 with the cost of environmental management after the implementation of PPSAK No. 12 on 2014, i.e. the initial assumption which states that there are differences in peel cost before and after the implementation of PPSAK No. 12 on 2014 supported.

Discussion

Cost of exfoliation of soil before and after application of PSAK No. 12 of 2014

The results of the t-test study of paired samples showed a significance value lower than 0.05 proving that there are differences between the variables of the cost of peeling before the application of PPSAK No. 12 of 2014 with the take-off cost after adopting PPSAK No. 12 of 2014, in other words the initial assumption that there are differences in the cost of peeling before and after the implementation of PPSAK No. 12 of 2014 supported.

In addition, the descriptive statistics also show that there is a difference which increases the average variable cost of peeling before applying PPSAK No. 12 of 2014 (0.0057) with peeling costs after PPSAK No. 12 of 2014. (0.025), this shows that there was an increase in the cost of peeling after the implementation of PPSAK No. 12 on 2014.

The results of the study which stated that there were differences between the peeling cost variables reflected the application of PPSAK No. 12 of 2014 in mining companies may increase the cost of stripping the soil layer in the production phase, according to research Aniela (2012), Angelia & Suryaningsih (2015), Lindrianasari (2007) dan Winarno, (2007) in his research proves that the application of environmental accounting has a positive impact on the financial and environmental performance of the company.

Although the results of this study do not prove the existence of PPSAK No. 12 of 2014 can improve environmental performance, but the results of this study offer the possibility of regulation and legitimacy

of PPSAK No. 12 of 2014 that the benefits future economic costs associated with the stripping activities will go to the relevant company, in accordance with the objectives of PPSAK No. 12 of 2014, the company will benefit only the stripping of the soil layer which can be transformed into supplies and increased access to a greater amount of material that will be mined in the future, since the material removed during stripping of the soil layer at the production stage is not always waste, often is a combination of minerals and waste. In addition, the application of PPSAK No. 12 of 2014 also has the principle of the overall recognition of the cost of stripping the soil layer in the production phase as an asset.

Environmental management costs before and after the implementation of PSAK No. 12 of 2014

The results of the study show that there are differences between the environmental management cost variables before the adoption of PPSAK No. 12 of 2014 with the cost of environmental management after the implementation of PPSAK No. 12 of 2014, in other words the initial assumption which states that there are differences in environmental management costs before and after the implementation of PPSAK No. 12 of 2014 supported.

The results of this study are illustrated by the average value of PPLH after the application of PPSAK No. 12 of 2014 is higher (0.06476) than the average value before the application of PPSAK No. 12 of 2014 (0.179505). These results indicate the existence of the obligation to apply PPSAK No. 12 of 2014 provides for an increase in the provisions that must be issued by mining companies linked to environmental management. The legitimacy theory says that businesses continue to try to ensure that they operate within the framework and standards that exist in the community or environment in which the business is located, where they are trying to ensure that their activities (business) are accepted by third parties as a legitimate activity (Natalia, 2014).

The results of this study show similarities to research conducted by Gray, Kouhy, & Lavers (1995) and Tristianasari & Fachrurrozie (2014), which proves that environmental performance and environmental disclosure simultaneously affect economic performance.

One of the objectives applied by PPSAK No. 12 on 2014 is to implement corporate social responsibility in accordance with the Law of the Republic of Indonesia No. 40 of 2007 on Limited Liability Companies (PT) in Article 74 stipulating that social and environmental responsibility is mandatory for companies managing natural resources and those that do not will hardly be subject.

Although mining companies do not need to be detailed, the function and role of PPSAK No. 12 of 2014 in the form of a calculation of the costs to be incurred in carrying out social responsibility incurred for mining activities as well as demanding losses incurred by the company, so that the company can be responsible for the environment and surrounding communities.

Through the application of environmental accounting, it is expected that the environment will be preserved, because by applying environmental accounting, the company will voluntarily comply with the government

policies in which the company operates. Of course, based on the results of this study, companies, especially the mining sector, should pay attention to environmental management costs as they are considered very important for environmental sustainability due to the mining process.

CONCLUSION

The purpose of this research to determine if there are differences in environmental costs in mining companies before and after the publication of PPSAK No. 12 of 2014 concerning stripping activities and environmental management.

1. The results of the study prove that there are differences between the variables of the peel costs before PPSAK No. 12 on 2014 with the cost of take-off after the adoption of PPSAK No. 12 on 2014, in others terms the initial assumption that there are differences in the cost of peeling before and after the implementation of PPSAK No. 12 on 2014 supported.
2. The results of the study show that there are differences between the environmental management cost variables before the adoption of PPSAK No. 12 of 2014 with the cost of environmental management after the implementation of PPSAK No. 12 of 2014, in other words the initial assumption that there are differences in the costs of environmental management before and after the implementation of PPSAK No. 12 on 2014 supported.

REFERENCES

- Angelia, D., & Suryaningsih, R. (2015). The Effect Of Environmental Performance and Corporate Social Responsibility Disclosure Towards Financial Performance (Case study to Manufacture, Infrastructure, and Service companies that are listed at Indonesia stock exchange). *Procedia-Social and Behavioral Sciences*, 211, 348–355.
- Aniela, Y. (2012). The Role of Environmental Accounting in Improving Environmental Performance and Corporate Financial Performance. *Periodical Scientific Accounting Student*, 1(1).
- Gray, R., Kouhy, R., & Lavers, S. (1995). Corporate Social and Environmental Reporting. *Accounting, Auditing & Accountability Journal*.
- Kusumastuti, S., Supatmi, S., & Literature, P. (2008). The Influence of Board Diversity on Company Value in the Corporate Governance Perspective. *Journal of Accounting and Finance*, 9(2), pp-88.
- Lindrianasari, L. (2007). The relationship between environmental performance and the quality of environmental disclosure with the economic performance of companies in Indonesia. *Indonesian Journal of Accounting and Auditing*, 11(2), 159–172.
- Martani, D. (2015). *Introduction to Effective IFRS-Based PSAK in 2015*. Jakarta.
- Natalia, R. (2014). The Effect of Sustainability Reporting on the Financial Performance of Public Companies in the Profitability Ratio. *Business Accounting Review*, 2(1), 111-120.
- Pamungkas, N., & Rusherlistyani, R. (2015). Implementation of IFRS in PSAK 64 in Mining Companies. *JOURNAL OF ECONOMIC & SOCIAL*, 1(01), 67–77.
- Tristianasari, G., & Fachrurrozie, F. (2014). Economic Performance Analysis of Mining Companies in Indonesia. *Accounting Analysis Journal*, 3(2).
- Winarno, WA (2007). Corporate Social Responsibility: Disclosure of Environmental Costs. *Journal of Accounting, University of Jember*, 5(1), 72–86.

Motor Programs as Indicators of Penalty Direction in Soccer

Luiz Felipe Pinto Oliveira da Motta¹; Ricardo Fontes Macedo²; Elizabeth Cárprio Rivera³; Angela Luciana De-Bortoli⁴; Robelius De-Bortoli⁵

¹Football Graduate Program, Federal University of Viçosa
felipe.motta55@gmail.com

²Tiradentes University – UNIT
ricardo10fontes@gmail.com

³Costa Rica University- UCR
elitacarpio@gmail.com

⁴Architecture Bachelor, Physical Education Graduate.
angeladebortoli.arquiteta@gmail.com

⁵PhD, Intellectual Property Sciences Postgraduate Program, Federal University of Sergipe, orcid.org/0000-0003-1231-6451 – ladec.ufs@gmail.com

Abstract

Introduction: *Many football games are decided on penalties and usually in championship final games. When seeking to anticipate movements, differences in amplitude can harm players because the informational movement appears to be spread "globally" throughout the action and should be coded at several levels. Thus, it would be interesting to analyze the entire period of the kick, since the player begins his run to approach the ball to recognize the motor patterns used in the kick that identify his direction.*

Objective: *The objective of this study is to identify patterns of behavior in penalty kicks that may indicate the direction of their action / kick and in my moment they appear.* **Methodology:** *The sample consisted of 21 subjects hitting a penalty kick, 18 males and 3 females with an average age of 22.18 ± 2.44 years and two goalkeepers with college football experience. The tests consisted of a battery of two penalty kicks for each subject in order to score. The kicks were recorded by a video camera with a front view of the goal goal and the back of the batter. The kick phases were divided into the starting leg position; first step leg; angle of the elbow in relation to the body seen from behind; angle of the elbow in relation to the displacement line seen from above; direction of the tip of the supporting foot and position on the goal where the kick was. Each kick was preceded by a start signal. The data were analyzed from the registration of each variable and the position of the goal in which the ball was kicked, considering it in three sectors: left, right and central.* **Results:** *The main results indicated that the variable "Leg of the first step" had 81% of the kicks associated with the direction of the goal; 52.4% of second kicks had repeated the pattern of behavior and 84.6% had repeated the pattern of behavior regardless of the goal position. The variable "Elbow angle in relation to the body seen from behind" had 81.8% repeated behavior pattern regardless*

of the goal position and the variable "Elbow angle in relation to the displacement line seen from above" had 81% association with the sector of the goal in which the ball was kicked; 52.4% of second kicks had repeated the pattern of behavior and 91.7% had repeated the pattern of behavior regardless of the goal position. **Conclusions:** The main conclusions indicate that it is possible to relate the kick location with the batter's body information; the start of the race seems to indicate that there is a prior intention of movement programs; the decision of where to hit the penalty appears to be made before contact with the ball and more closely to the placement of the support foot and with this relationship, the size of the goal to be defended by the goalkeeper could be reduced, increasing the possibility of defense.

Keywords: Motor Program; Sport; Cognitions

1. Introduction

Many games are decided on penalties. Generally, decisions for maximum penalties are made at decisive championships. In the 9 recent world football matches from 1982, 26 games were decided by maximum penalties, including in two finals, totaling 240 kicks. Among the winning teams, 86.1% of the penalties hit were converted, showing a gap that should be studied when looking for sports performance in football.

In the literature, it is possible to find studies that analyze the characteristics of young people considering the variables of physical and quantitative nature, accounting for the number of touches on the ball or shots on goal, mentioning motor skills (Neves, 2010). Silva-Junior et al. (2011) also analyze soccer players according to their physical characteristics, emphasizing that muscular endurance, speed and acceleration are motor skills.

With regard to specific goalkeepers, Gonçalves (2010) compares them with players from other positions. In his study, the goalkeeper has lower aerobic capacity and greater agility and vertical thrust than other players. Other authors dedicate themselves to studying behavioral variables saying that the team actions at the moment of the recovery of the ball possession are modified according to the current result and the quality of the opponent (Andrade, 2010).

Almeida (2010) analyzes the offensive sequences in youth soccer and reduced situations of 4 and 7 athletes, also demonstrating the importance of analyzing the player's cognitive aspect. This line is reinforced with the studies of Giacomini, Soares, Santos, Matias and Greco (2011) when they affirm that the quality in sports performance, in collective sports games, is related to cognitive abilities, especially with knowledge.

There are also authors such as Ruschel, Haupenthal, Hubert, Fontana, Pereira, and Roesler (2011) who studied the simple reaction time and football players. His study found no differences in Visual Reaction Time between categories, but only Auditory Reaction.

Bourne et al. (2013) analyzing penalty in handball supports the hypothesis that the anatomical regions closest to the ball would be better informative for anticipation and Roca et al. (2013) state that qualified soccer players, compared to less skilled players, make more precise anticipations and decisions due to quantitative differences in their perceptual and cognitive processes.

This study originates from the theory of motive communication, a study previously carried out by Araújo, Caniçali, De-Bortoli, and De-Bortoli (2003) where a strong relationship was found between information sent by the attacker at the time of the penalty and the direction of the ball and it is based on the expectation of knowing if it is possible to decrease the penalty taker's advantage and increase the chances of the goalkeeper to save the penalty from the early identification of the direction of his shot.

The objectives are to identify if there is a pattern of behavior in penalty kicks that may indicate the direction of their action / kick; verify that the kicking motor program is organized before commencing displacement or is defined during commuting for execution and identifying positive motor communication during a penalty kick.

For this, hypotheses H0 were formulated: penalty kicks follow random motor patterns and H1: penalty kicks follow predefined motor action patterns.

2. Method

Kind of study

Inductive, transversal, empirical

Sample

The sample consisted of 21 penalty takers, 18 males and 3 females with an average age of 22.18 \pm 2.44 years and two goalkeepers with college football experience.

Instruments

The tests consisted of a sequence of two penalty kicks for each subject in order to score. The kicks were recorded by a video camera with a front view of the goal and the back of the batter. The kick phases were divided into the starting leg position; first step leg; angle of the elbow in relation to the body seen from behind; angle of the elbow in relation to the displacement line seen from above; direction of the tip of the supporting foot and position on the goal where the kick was directed. Each phase described above was considered as a study variable (Chart 1).

TABLE 1 - Variables and their respective execution indicators.

Variable	Indicators		
V1 – Starting leg position	P: Parallel leg	D: Diagonal leg	X: Unable to identify
V2 – Leg of the first step	P: Parallel leg	D: Diagonal leg	
V3 - Angle of the elbow in relation to the body seen from behind	P: <33 degrees	X: >33 and <66 degrees	D: >66 degrees
V4 - Angle of the elbow in relation to the displacement line seen from above	P: <33 degrees	X: >33 and <66 degrees	D: >66 degrees
V5 - Direction of tiptoe support	P: Parallel	C: Center	D: Diagonal
V6 - Position on the goal where the kick was directed	P: Parallel	C: Center	D: Diagonal

Procedures

Each kick was preceded by an audible start signal and between kicks an interval of not less than 60 seconds or more than 120 seconds was observed. The data were analyzed from the registration of each variable and the position of the goal in which the ball was kicked, considering it in three sectors of the same dimension: left, right and central.

Statistical analysis

The results were analyzed descriptively. The conclusions were counted and variables V1 to V4 were related to the sector in which the ball reached the goal (V6). The first kicks and then the second kick of each subject were related. Subsequently, the first was related to the second kick of each subject. The variable V5 was disregarded in the presentation of the results because it was noticed that, at least in the way it was proposed, there was no clarity in its interpretation. Thus, it was decided to disregard it.

Ethical care

This study observed the ethical standards that aim to preserve the physical and psychological integrity of the participants, protecting them from any possible risks, during and after their participation. All subjects were volunteers and, after being informed of the study protocol, expressed their acceptance to participate by signing a free and informed consent form with two witnesses. The data from the study is stored in a specific location and only researchers have access to it.

3. Results

Figure 1 shows the percentage results of the relationship between variables V1 to V4 and variable V6. The data are presented in three columns. The first refers to total kicks, the second to the first kicks and the third to the second kick of each subject. It is observed that the variables V2, V3 and V4 showed a greater relationship with V6 in the second kick.

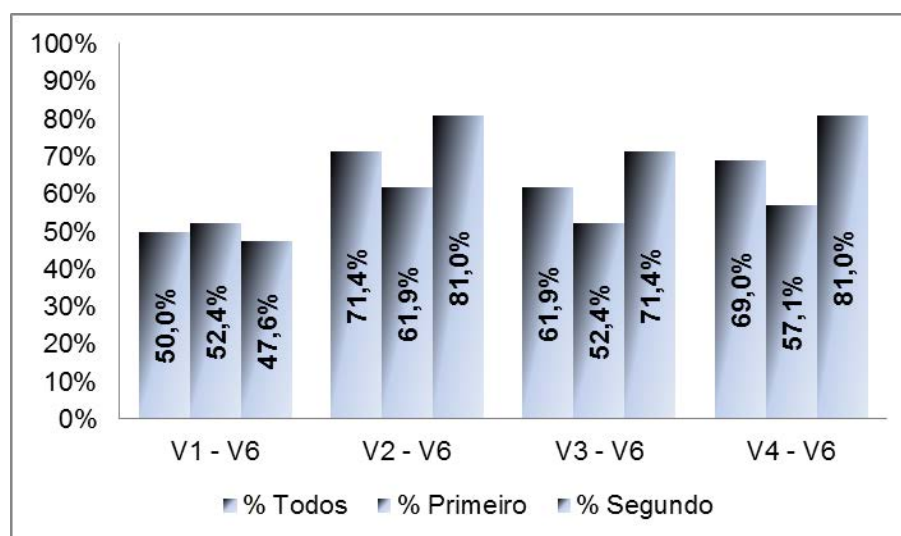


Figure 1. Relationship between variables V1 to V4 with the sector in which the ball reached the goal (V6). *Todos: All; Primeiro: First; Segundo: Second

When the behavior patterns between the first and second kicks for each subject were analyzed, it was observed that the variables V2 and V4 had a higher percentage of repetition of the combination between the variable and the goal sector (Figure 2), that is, repeated pattern and sector.

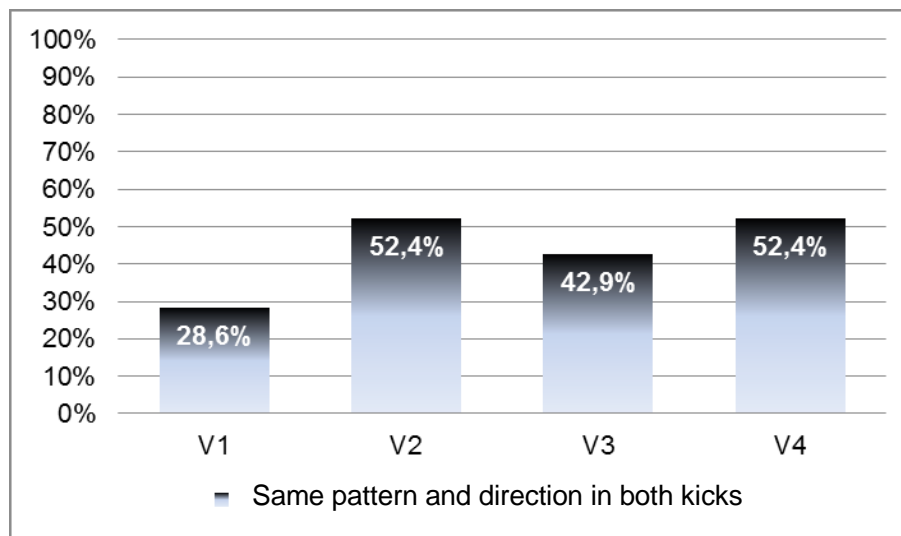


Figure 2. Repetition of the movement pattern and sector of the goal for each subject, in both kicks.

When the behavior patterns between the first and second kicks for each subject were analyzed, regardless of the sector in which the ball reached the goal, it was observed that the variables V2, V3 and V4 had a percentage above 80% of repetition of the combination between the variable and the target sector (Figure 3), that is, when you changed V6, you adjusted the other variables as well.

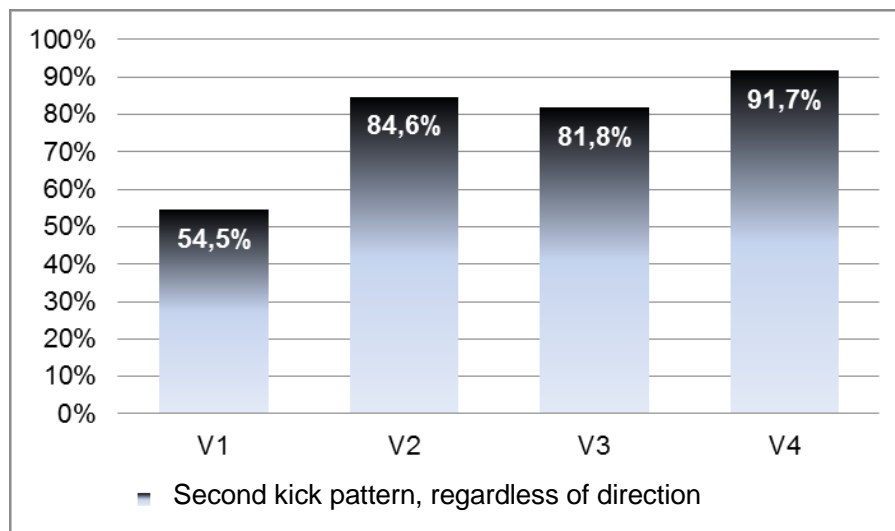


Figure 3. Repetition of movement pattern for each subject, in both kicks.

4. Discussion

When analyzing the results, it is noticed that the signs of motor communication are present when

more than one study variable is mapped. If we consider that the second kick may have more dedication from the subject because the psychological load of the repetition may be stronger, we observe values of relation between the variables very high. These results confirm Bourne et al. (2013) when they state that the informational movement appears to be spread "globally" throughout the action and to be coded in motion at various levels. The way in which this information is extracted appears to be skill dependent, and as an attempt to quantify the most pertinent (or disturbing) information to artists across the spectrum of skills in making anticipatory judgments. They even recommend that it would be useful to investigate the informative value of individual location trajectories as well as the relative movement within specific anatomical structures.

Another study that partially supports this analysis aimed to find out the differences that exist depending on the level of competition in laterality, the kick zone and the effectiveness of the penalty in professional professional soccer athletes. The results found showed that the most effective kickers were not the ones who play at a higher level of competition, although the differences found are reduced (Palau et al., 2010). Considering driving communication as a reality, this result confirms the study gap for further systematization of specific training, as it would be expected that athletes with a higher competitive level would have better results in this analysis.

When analyzing a study with tennis players, Smeeton, N.J. & Huys, R. (2011) state that differences in range of motion can impair the anticipation of stroke direction in low-qualified tennis players. This discovery may help to understand how deceptive actions can elude individuals with a low level of skill, while individuals with a higher level of skill are unaffected, reinforcing the hypothesis that there is a codification of the movement.

An interesting data that should be highlighted is the study by Roca et al. (2012). They identified that the average number of hours accumulated per year during childhood during specific soccer activities was the strongest predictor of perceptual-cognitive knowledge. Specific soccer practice activity during adolescence was also a predictor, although its impact was relatively modest. No differences were found between the groups regarding the number of other sports involved during development, or for some of the main results achieved.

The different values in each variable may be related to the fact that some body segments are more strongly related to the kick sector. Navia et al (2013) suggest that visual behavior can be very different in each situation. In a study with goalkeepers, they identified that when the goalkeeper makes the base for the defense, his gaze approaches the ball just before the kick to later direct his attention to the playing field in front of the ball. These results suggest that the athletes studied do not pay attention to the other variables prior to contact with the ball.

This factor could be explained with the argument that, during the teaching / learning process, it would be essential to isolate the disturbing factors of success in tasks, including the decrease in the focus of attention (Silva et al., 2012), but the body variables prior to kick may not be disturbing factors, but relevant signs of its direction. But one must pay attention to the anticipation performances. Qualified players differentiate themselves by perceiving low-dimensional dynamic structures in all deceptive and non-deceptive actions while less qualified players are deflected by exaggerated movement, which may reflect on the perception of range of motion in these actions (Smeeton, NJ & Huys, R., 2011).

When considering the possibility of repetition of the sector in two shots, the results do not make it possible to affirm that there is a repetition of goal sectors, as it seems that there was an alternation in the choice of runs. Thus, if each kick is analyzed in isolation, there may be a disturbance of interpretation. Analyzing the seven-meter handball shot, equivalent to the soccer penalty, Bourne et al. (2011) state that the objective of any follow-up work should be to identify which, if any, of the dynamic structures of observers the opportunity to distinguish between different movements in a reliable way.

We believe that players are better able to learn and consolidate their decision making (do it) than acquire conceptual knowledge (know what to do), as they show in explaining what, how, when and why technical-tactical actions performed on the playing field. As a result, his performance in the field is of a higher standard than his theoretical declarative and procedural knowledge.

This position seems to be the same as Garcia et al. (2011) when they consider that the variability training is more effective than the specificity training for handball and Navia et al. (2013) when analyzing the direction of the attention of a group of experienced futsal goalkeepers in the task of defending a penalty, simulated in the laboratory and under two different response conditions: without initial movement and with moving to position themselves in defense. In their conclusions they say that it would be interesting to analyze the entire kicking period, since the player starts his run to approach the ball, with the aim of understanding the extent to which (or not) the divergence of visual strategies between the different responses takes place.

The most relevant data obtained in this study is the large percentage of repetition of patterns between the first and second kicks, regardless of the sector of the goal in which the ball was thrown and some variables, a higher percentage.

From the goalkeeper's point of view, the literature seems to bring similar results, as the study by Navia et al. (2013), which indicates that goalkeepers direct their anticipatory attention to the lower areas of the ball. By analyzing cricket batsmen, they responded to video simulations of opponents by throwing a cricket ball in conditions of high and low contextual information. Qualified scouts were more accurate, demonstrated more effective search behaviors, and provided more detailed verbal reports of thinking (McRobert et al., 2011), reinforcing the understanding that driving communication in soccer could be better trained in soccer, especially for soccer players. goalkeepers.

An explanation that suggests that there is no predetermination of motor programs in penalty kickers is a consequence of the studies by Palau et al. (2010). The results found by them showed a tendency for kickers to choose the side of the goal according to their laterality, or preferred kicking leg. Right-handers tended to kick on the right side of goalkeepers and ominous on the left side, that is, diagonal kicks, according to the criteria of this study. But the results also indicated that sinister first division players did not confirm this trend. The authors' interpretation is that the analyzed subjects may have greater capacity for variability in their execution, which supports our hypothesis.

This argument seems to be suitable for field players as well. According to a study by Roca et al. (2013), in 11 versus 11 football with life-size images, skilled players reported more accurate anticipation and decision-making than less skilled players, with their superior performance being supported by differences in search behaviors for specific tasks and processes of thinking.

5. Conclusion

The analysis of isolated results and almost outside the real context of the game is very difficult because it takes the pressure away from the task linked to performance a little, and can convert an ultimate game action into a playful task. This is a limitation of the studies, which makes interpretations almost always assumptions. For this reason, this study is positioned to test a hypothesis inductively, without mathematical proof, but with argumentation.

Thus, it seemed evident that it is possible to relate the kick's location on the goal with the batter's body information, as there is a good percentage of relationship between the kicker's body variables and the direction of the ball. With this relationship, the size of the goal to be defended by the goalkeeper could be reduced by at least a third, increasing the possibility of defense.

The displacement of the goalkeeper prior to the kick could be a stressful factor for the batsman, which would cause benefits to the goalkeeper, just as the start of the race seems to indicate that there is a prior intention of movement programs. The decision of where to hit the penalty appears to be made before contact with the ball and more closely to the placement of the support foot, which would give the goalkeeper a temporal advantage to start the move towards the defense and, mainly, to the correct side of the goal.

Some limitations of this study are related to the number of subjects and the distance between the test situation and the real game. In order to minimize this limitation, the sequence of kicks was sought, which seemed interesting, since a pressure value was added to the kicker in the second attempt that seemed positive. As a suggestion for future studies, a series of at least five kicks could be used for each subject.

6. Acknowledgement

Special thanks to our team in two countries.

7. References

- Almeida, C. H. G. C. Caracterização das Sequências Ofensivas no Futebol Juvenil: Efeitos da Experiência e de Variantes Reduzidas do Jogo. 2010. Dissertação (Mestrado em Treino do Jovem Atleta) Faculdade de Motricidade Humana, Universidade Técnica de Lisboa, Lisboa.
- Andrade, C. A. Análise do Processo Defensivo no Futebol. Acções e comportamentos defensivos associados à recuperação da posse de bola em diferentes contextos do jogo. 2010. Dissertação (Mestrado em Treino do Alto Rendimento) Faculdade de Motricidade Humana, Universidade Técnica de Lisboa, Lisboa.
- André Roca, Paul R. Ford, Allistair P. McRobert, and A. Mark Williams (2013). Perceptual-Cognitive Skills and Their Interaction as a Function of Task Constraints in Soccer. *Journal of Sport & Exercise Psychology*, 35(2), 144-155.
- Andre' Roca, A. Mark Williams, & Paul R. Ford (2012). Developmental activities and the acquisition of superior anticipation and decision making in soccer players. *Journal of Sports Sciences*, 1–10.
- Araújo, E. C. ; Caniçali, P. L. C. ; De Bortoli, A. L. e De Bortoli, R. Comunicação motriz no chute do futsal.. In: IX Congresso Nacional de Psicologia de la Actividad Física y el Deporte - Perspectiva

- Latina, León. Libro de Actas. León, Espanha: Universidad de León, 2003. p. 398-407.
- Bourne, M., Bennett, S. J., Hayes, S. J. & Williams, A. M. (2011). The dynamical structure of handball penalty shots as a function of target location. *Human Movement Science*, 30(1), 40-55. DOI: 10.1016/j.humov.2010.11.001
- García, J. A., Moreno, F. J. & Cabero, M. T. (2011). Efectos del entrenamiento en variabilidad sobre la precisión del lanzamiento de siete metros en balonmano. *Revista de Ciencias del Deporte*, 7(2), 66-67.
- Giacomini D.S.; Soares V.O.; Santos H.F.; Matias, C.J. e Greco, P.J. O conhecimento tático declarativo e processual em jogadores de futebol de diferentes escalões. *Motricidade*, v. 7, n. 1, p. 43-53, 2011.
- Gonçalves, R. R. Perfil morfológico e funcional do jovem guarda-redes de futebol. 2010. Dissertação (Mestrado em Treino Desportivo para Crianças e Jovens) Faculdade de Ciências do Desporto e Educação Física, Universidade de Coimbra, Coimbra.
- McRobert A. P., Ward, P., Eccles, D. W. & Williams A. M. (2011). The effect of manipulating context-specific information on perceptual-cognitive processes during a simulated anticipation task. *British Journal of Psychology*, 102(3), 519-34.
- Michael Bourne, Simon J. Bennett, Spencer J. Hayes, Nicholas J. Smeeton & A. Mark Williams (2013). Information underpinning anticipation of goal-directed throwing. *Atten Percept Psychophys*, 75(7):1559–1569, DOI 10.3758/s13414-013-0485-2
- Navia, J.A.; Ruiz, L.M.; Graupera, J.L.; Van der Kamp, J. (2013). La mirada de los porteros de fútbol-sala ante diferentes tipos de respuesta motriz. *RICYDE. Revista Internacional de Ciencias del Deporte*, 33(9), 269-281. DOI 10.5232/ricyde2013.03305
- Neves, J. M. P. Caracterização multidimensional de jogadores de futebol com 13-14 anos: Estudo com equipas da Associação de Futebol de Coimbra. 2010. Dissertação (Mestrado em Educação Física) Faculdade de Ciências do Desporto e Educação Física da Universidade de Coimbra, Coimbra.
- Palau, J. M., López-Montero, M. & López-Botella, M. (2010). Relación entre eficacia, lateralidad, y zona de lanzamiento del penalti en función del nivel de competición en fútbol. *Revista Internacional de Ciencias del Deporte*, 19(6), 153-66.
- Ruschel, C.; Haupenthal, A.; Hubert, M.; Fontana, H.B.; Pereira, S.M. e Roesler, H. Tempo de reação simples de jogadores de futebol de diferentes categorias e posições. *Motricidade*, v. 7, n. 4, p. 73-82, 2011.
- Silva Neto, M.; Simões, R.; Grangeiro Neto, J. A. e Cardone, C. P. Avaliação Isocinética da Força Muscular em Atletas Profissionais de Futebol Feminino. *Revista Brasileira de Medicina do Esporte*, v. 16, n. 1, p. 33-35, 2010.
- Silva, L. A., Silveira, J. W. P. & Skubisz Neto, A. (2012). Comparação de modelos de práticas na performance do arremesso do lance livre no basquetebol. *Revista Mackenzie de Educação Física e Esporte*, 11(2), 120-128.
- Silva-Junior, C.J.; Palma, A.; Costa, P.; Pereira-Junior, P.P.; Barroso, R.C.L.; Abrantes-Junior, R.C. e Barbosa, M.A.M. Relação entre as potências de sprint e salto vertical em jovens atletas de futebol. *Motricidade*, v. 7, n. 4, p. 5-13, 2011.
- Sixto González-Víllora, Luis Miguel García-López, David Gutiérrez-Díaz, Juan Carlos Pastor-Vicedo

(2013). Tactical awareness, decision making and skill in youth soccer players (under-14 years). *Journal of Human Sport And Exercise*, 8(2), 412-426. DOI: 10.4100/jhse.2012.82.09

Smeeton, N.J. & Huys, R. (2011). Anticipation of tennis-shot direction from whole-body movement: The role of movement amplitude and dynamics. *Human Movement Science* 30(5), 957-965. DOI: 10.1016/j.humov.2010.07.012.

Education and sustainability in times of covid-19 pandemic

Tayronne de Almeida Rodrigues

(Corresponding author)

Master's degree student in Sustainable Regional Development at Universidade Federal do Cariri (Proder/UFCA). History Professor attached to Secretaria da Educação do Estado do Ceará, (SEDUC), Brazil.

Email: tayronnealmeid@gmail.com

Estelita Lima Cândido

Biotechnology PhD from Rede Nordeste de Biotecnologia, (RENORBIO), Brazil. Associate Professor at Universidade Federal do Cariri, Professor of the Master in Sustainable Regional Development at Universidade Federal do Cariri - (Proder/UFCA).

Email: estelita.lima@ufca.edu.br

Francisca Laudeci Martins Souza

Education PhD from the Universidade do Estado do Rio de Janeiro, Brazil. Master's Degree Professor in Sustainable Regional Development at Universidade Federal do Cariri - (Proder/UFCA), Associate Professor at the Economics Department of Universidade Regional do Cariri (URCA).

Email: laudecimartins@gmail.com

Abstract

COVID-19, a disease caused by the coronavirus was first identified in China in December 2019. At the end of January, the World Health Organization declared the epidemic to be a Public Health Emergency of International Importance and on March 11, 2020, a pandemic. The global pandemic generated by COVID-19 and the consequent mandatory population confinement measures implies unforeseen events and challenges for education systems. The objective of the article is to reflect on this issue from a sustainability perspective. Thus, what are and should be the functions of the school, in view of sustainability, in the context of the current COVID-19 pandemic; as well as in supposed future waves of emerging and re-emerging diseases? It seeks to discuss the importance and challenges for the insertion of proposals in Education for Sustainability in the school environment. These issues are at the center of the Sustainable Education debates, and thus the article seeks to reflect on this subject from an educational and sustainable approach. To this end, it is not necessary to conduct a brief review of the functions of educational systems indicated by sustainability in Education, as well as their repercussions and meanings in terms of environmental, social and health development (personal or collective). The research was conducted through literature review and theoretical discussion; of an exploratory and descriptive nature, of a qualitative nature. The results corroborate that the pandemic, by causing a serious global health problem, also extending to a global economic crisis, led the planet to a great recession that directly threatens the achievement of Sustainable Development objectives. Thus, it is up to Education, whether at

a distance in this context of distance/social isolation, or even after this situation in a classroom manner, to include an agenda of transversal contents on sustainability in the curriculums of all systems, modalities and educational spheres in Brazil.

Keywords: Education; Sustainability; Health; COVID-19.

1. Introduction

COVID-19, a disease caused by the coronavirus, was first identified in China in December 2019. The clinical spectrum of infection is very broad, ranging from a simple cold to severe pneumonia. People with COVID-19 develop signs and symptoms, including mild respiratory problems and persistent fever (LIMA, 2020). According to the Ministry of Health, transmission occurs by touching contaminated hands; droplets of saliva; sneezing; coughing; phlegm, and contaminated objects or surfaces, which makes the use of masks and alcohol 70 % very important.

According to BBC Brazil, in July 2020 there were more than 18 million people infected worldwide, with more than 700,000 deaths. COVID-19 imposed on the world population new challenges in the sanitary, social, economic, and educational contexts, severely exposing to the world the weaknesses of the greatest economic powers and confirming the impotence of those economically underprivileged.

For Dovers and Handmer (1992) sustainability is the ability of a human, natural, or mixed system to resist or adapt to internal and external change indefinitely. For Elkington (1994) sustainability is the balance between environmental, economic and social. Sustainable Development has sustainability as its goal. The term Sustainable Development was widely disseminated from the publication of the report Our Common Future in 1987, with interpretations ranging from the conciliation of economic growth with the environmental variable, of capitalist bias, to more radical visions that defend ecological integrity, favorable to the development of sustainable social practices (HERCULANO, 1992 apud CARLETOO et al., 2006). The way we live, based on capitalism, on the unbridled purchase of goods needs to be rethought, COVID-19 demonstrates the fragility of this system, in relation to human life and the need for a sustainable development, based on human, animal and, above all, environmental well being.

The widespread closure of all educational centres at the classroom level raises a fundamental question: What is the school for in terms of sustainability? What are and should be its functions, in view of sustainability, in the context of the current COVID-19 pandemic? As well as in supposed future waves of emerging and re-emerging diseases?

The purpose of this thought session is to discuss the importance and challenges for the insertion of proposals in Education for Sustainability in the school environment. These issues are at the center of the debates on Sustainable Education and, in this way, the article aims to reflect on the subject from an educational and sustainability approach. To this end, it is not necessary to conduct a brief review of the functions of educational systems indicated by sustainability in Education, as well as their repercussions and meanings in terms of environmental, social and health development (individual or collective).

Also, the impacts of the current situation on the exercise of sustainability and a reflection on its multiple repercussions in terms of educational opportunities are discussed. Therefore, the theme is presented in order

to mark the role of the school as a specialized institution in the construction of deep, relevant and meaningful knowledge for each learner.

2. Methodology

It is a qualitative study of exploratory and theoretical depth, supported by literature review and critical discussion. The qualitative approach aims at deepening a subject in question, describing information instead of measuring it (source). The literature review is a synopsis that summarizes different investigations and articles that present the current state of the issue to be investigated and allows a critical evaluation of other research on the subject (GIL, 2017).

The research was carried out at the Capes Periodical Portal, where we inserted as keywords the term "Sustainable Education" and found 3,108 articles published between 1992 and 2020, the vast majority published in English (2,022) and Portuguese (1,784). We filtered the search for articles published between 2018 and 2020, in the Portuguese language, finding 341 articles, we also refined for articles in Brazil, having a total of 64 articles, we selected the first 10 journals to use in our analysis.

3. Results and discussion

3.1 The gaps in unsustainability practices in education

For Dovers and Handmer (1992) sustainability is the ability of a human, natural, or mixed system to resist or adapt to internal and external change indefinitely. For Elkington (1994) sustainability is the balance between environmental, economic and social, Sustainable Development aims to promote sustainability. The context of confinement has made explicit the multiple gaps that cross our educational system and systematically place social groups at a greater disadvantage at school. In addition to the differences within the public school itself, we highlight the difference with respect to the private educational system, whose technological conditions of the school and the students are different from those of the public educational system, whether municipal, state or federal.

There are still an insignificant number of articles, specialized reports or other scientific papers that have been published recently on this issue. However, in view of the referred authors, they present the gaps in the area of health, education, as well as the economic, social, cultural, emotional and technological issues that are evidence of the need to develop education for Sustainable Development, the COVID-19 pandemic demonstrates the urgency for new methodologies and debates within the school aiming at a development based on sustainability, that is, on the balance with the environment. The reality presented and amplified by the lack of sustainability reveals citizens alone, disoriented and distressed. Also, families have been left without work all over the world, increasing the number of people in situations of socioeconomic vulnerability. The pandemic is demonstrating the economic fragility and the lack of preparation of the governors and people in general to deal with it. It is a global and economic health crisis, and in some countries a political crisis as well.

Before wondering what is expected of the world after the pandemic, it is worth reflecting on what humanity has been experiencing. According to Silva and Pontes (2020), the crisis highlights the problems of society that have been present for many years, such as the precarious health system, inequality in access to water,

social inequalities, devaluation of the countryside and agriculture, insecurity in employment and the privilege of capitalism instead of taking care of life.

One of the Ministry of Health's actions was the provision of new means of care to the population, such as the Coronavirus-SUS application and the WhatsApp. The guidelines since the beginning of the pandemic have consisted of washing hands with soap and water or sanitizing with alcohol gel, covering the nose and mouth when sneezing or coughing, social distancing, not sharing personal objects and maintaining the habit of ventilating environments. From April 2020, the Ministry of Health started to guide the population to use cloth masks to act as a barrier to the virus (LIMA, 2020, p. 2).

Currently, "washing hands" or "staying at home" are not acts to which everyone has access. This new situation has allowed society to become more aware of its interdependence with all people in a complex and delicate network of relationships, as well as with other forms of life with which beings coexist. Washing hands is basic and prevents a number of diseases that precede COVID-19, but it has never been so encouraged and stimulated. According to the G1, communities like Chatuba de Mesquita, Camarista Méier and Complexo do Alemão, which are located on the outskirts of the city of Rio de Janeiro, were long without water during the coronavirus pandemic, without assistance from governments¹, which demonstrates the lack of development, especially in poor communities, since water is an indispensable resource for survival.

Therefore, the pandemic has generated uncertainty and fear because it is known that it cannot be controlled. However, fear and confinement have become an opportunity to reflect and, at the same time, to forge hope that this situation will allow citizens to rethink the importance of including sustainability concepts strongly in the school curriculum in order to deal more effectively with scenarios like this. Although social isolation is recommended, a large part of the population has not been able to comply with this measure, due to socioeconomic vulnerability or because they work in sectors considered indispensable, such as the market, pharmacy and hospitals.

The world faces a new disease and a situation considered unusual, which requires radical changes in behavior at individual and community levels. All should follow the guidelines of health authorities, based on available scientific evidence and aligned with the recommendations of the World Health Organization, respecting quarantine and travel and social contact restrictions (LIMA, 2020, p.5). Even with the disclosure of case numbers and deaths by COVID-19, at the global, national and even local levels many people continue to disrespect protection measures, one of the consequences of the unrestrained disclosure of fake news.

In this regard, it is recommended, based on Filho (2020), that transversal themes, linked to the concept of sustainability, be inserted in the educational curriculum, privileging solidarity, responsibility and awareness of the impact of our actions as a species. In this trajectory, it is believed that a different system may emerge in which life is privileged over the economy, in which access to health, the conditions of medical personnel and health institutions are improved in the national territory, as well as in all countries.

To do so, it is necessary to redefine what it means to live well, to share with the family, to be healthy, to belong to a community; that is, to change the concept of well-being, which many human beings have,

¹ Available at: <https://g1.globo.com/rj/rio-de-janeiro/noticia/2020/03/17/moradores-de-comunidades-do-rj-sofrem-com-falta-de-agua-em-meio-a-pandemia-de-coronavirus.ghtml>. Access on July 20, 2020.

linked to the economy, production and consumption and, consequently, in the opposite direction of sustainability.

3.2 Education, Sustainability and the COVID-19 Pandemic

Education for sustainability emerged in the mid-1980s, from the global conferences, becoming a hegemonic current in the field of education through the recommendations of UNESCO after Rio-92, with the central objective of contributing to sustainable development, because it assumes that economic development is inseparable from the conservation of natural resources (ANTUNES et al., 2018, p.265). It is necessary for the school, together with the family, to educate for rational consumption and for the reduction of residuals and waste, because the preservation of the planet needs to be collective (MIGUEIS, 2014, p.2).

Sustainable development emerged as an alternative to overcome the installed environmental crisis, an alternative related to economic, social and cultural issues, and is explicit in the five dimensions of sustainability: social, economic, ecological, spatial and cultural. Capitalism is based on an unequal and exclusive economic model that disregards the environmental and social costs of production (CARLETTO, et., al 2006).

COVID-19, a pandemic that has shaken the world's structures, demonstrates the urgency for an education that makes individuals rethink and reflect on how they relate to the environment. The accelerated pace of life, the individualism characteristic of modern society, the lack of quality relationships and the lack or little concern with the environment, show the need to combine education with sustainability, through principles of ecology, personal and collective health, solidarity, reciprocity, cooperation, empathy among other factors (SAPIRO et al., 2020).

Today, technology takes on new meanings whether in the continuity of education classes or in the role of interconnecting the communication of loved ones. In this sense, it is inferred that technologies and new media are creative and innovative ways to bring people in isolation together and, in this way, could help to create a society that is a little more solidary in which there is mutual care and ways to support each other (CECCON & SCHNEIDER, 2020).

According to the above-mentioned authors, through technology, it is possible to gather information and acquire knowledge as pertinent to moments such as the current one, such as epidemiology and collective health studies, through this knowledge tool that allows breaking down systemic barriers and thus can be listed as a sustainability partner, if properly used.

It is also worth mentioning, according to Filho et al. (2020), that the pandemic is also an appeal to governments, not only to reassess and improve investments and programs related to education, science and technology, but also to question the content and impact of such programs mainly on education.

With regard to education for sustainability, it is important to stress that technological developments point to the same market that decides what is being researched and what the priorities for technological development are (GALLELI, 2018). In other words, there is a need for a change in this direction, to face possible new waves of contamination after the pandemic, or even to better fight the supposed new endemics and pandemics, besides a greater concern with prevention. The lack of sustainability affects everyone in society in the short or long term, situations such as this one experienced due to COVID-19 demonstrate that there is much to be done to improve the living conditions of the world population. Capitalism preaches

social inequality, which in times of crisis massively affects the most economically vulnerable populations. According to Henrique and Goebel (2020), it is also important to reflect on the curriculum - a device that sustains knowledge - that educational institutions are extending to students, who in a standardized way reproduce diagrammed concepts about how the world is perceived and how society interacts with it. Therefore, the importance lies in rethinking the educational system, because that is where the basic knowledge is usually acquired so that individuals can relate to the world and to their peers in a sustainable manner.

If it is a desire to address the impacts of this pandemic, as well as of other diseases to come, it is time to rethink education, starting with the way knowledge is accessed, and also to reflect on the quality of the information received and on one's attitude towards the information that arrives. It may be the time to find ways to feel-think from an educational point of view and to promote a dialogue of knowledge, oriented towards a more sustainable and solidary life.

3.3 Lessons not to be forgotten

From an epistemological point of view, the pandemic shows us the need to diversify knowledge and to have better strategies for the social and sustainable appropriation of science (MARTINS et al., 2020). Due to the rupture in the social fabric that the measures against the coronavirus impose, changing the forms of coexistence, it is not enough just decrees of rulers recommending quarantine and isolation, but mechanisms of awareness that produce meaning to the population, aiming to ensure the adoption of practices by society (CECCON; SCHENEIDER, 2020).

The school is the right environment to foster responsible attitudes and environmental sustainability, because it offers citizens educational actions and develops collective and individual conduct, but it needs the entire community to be involved in the action, and to have a democratic management, with a commitment to educate for rational consumption and the reduction of residues and waste (MIGUEIS, 2014, p.6).

Following this line of thinking, epidemics and pandemics could lead citizens to take more seriously the need to ensure sustainability, for example, in order to be better prepared for future crises. The socially practiced food system reflects high levels of consumption, production and marketing of essential products from long supply chains. Educating for sustainability makes a positive contribution to improving the quality of life on the planet as a whole, but few schools are yet concerned with practices aimed at sustainability, due to a lack of structure, democratic management, dialogue and community involvement (MIGUEIS, 2014, p.14).

Therefore, it would be possible to reduce certain vulnerabilities in scenarios generated by human action and its impact on the planet. According to Henrique & Goebel (2020), it is time to understand that ecosystems support the economy and health, not the other way around. Treating nature disrespectfully has consequences for all human beings. Through sustainability, society, represented in its individuals, can acquire a new awareness of relationship and interrelationship with nature and, thus, one can think less individually and give value to the collective.

It is paramount that education can work on the impact of individual behaviour on social dynamics and the well-being of others. To do so, society, during and after this pandemic, needs to focus its efforts and energies on the well-being of the population, by virtue of the solidarity we must build as a species (GÓES et al.,

2020).

This is a call to work from sustainability, at last solidarity and empathy as a society where everyone can and should have access to the essentials of life. It is about converting what are today privileges into rights. Comprehensive health and quality education should be a right for all as a society. The planet has been put on hold and now we hear in a different way from nature. Without planning it, we are taking care of the environmental recovery and it is in our hands to start building forms of coexistence in solidarity with the environment. Education for sustainability is already being practiced in some schools in Brazil, but in a very timid way, with few supporters, the pandemic that we face demonstrates the emergence of an education focused on sustainability, so that we can maintain, or rather, create a balance with the environment, and promote social equality. The pandemic has demonstrated several problems that have been latent for a long time in our society, such as the lack of water, sanitation and economic security, it has demonstrated that we are susceptible to new pandemics and that we need to rethink the way we live.

4. Conclusion

As COVID-19 dramatically changes lives and livelihoods around the world, the policy debate needed to contain it is increasingly broadening, highlighting a number of multilateral solutions to alleviate the pandemic. In this regard, the commitment of Education to achieve the objectives of Sustainable Development emerges.

Therefore, Education has the prerogative to achieve progress that will help the world overcome the health emergency through Sustainability, including the discovery of a vaccine. A better reconstruction of educational strategies is therefore necessary; since, although the virus affects everyone, it has not affected them equally, but has exposed and exacerbated inequalities in societies and the lack of sustainable practices combined with an education concerned with collective health and social responsibility.

These disparities exacerbated in times of pandemic can serve as a catalyst and a call to rebuild a school curriculum that has sustainability practices based on personal and collective health practices, human rights and specific measures in each country as its flagship should take into account the incidence of special situations, such as poor hygiene and sanitation conditions found in a wide range of developing countries.

Following this trajectory, COVID-19, as well as others that may emerge, like the pigs in China as a new global pandemic, with a new subtype of H1N1, a consequence of a "genetic rearrangement" with the virus that caused the pandemic in 2009. It has managed to move from pigs to humans, but there is still no record of infection among people (G1)². Highlights the need to encourage Sustainable Education, still little practiced in Brazil, with emphasis on understanding multilateral cooperation, governance in health and, above all, global solidarity. In the context of the current picture, it can be observed that the Sustainable Development objectives ventilated by Education can serve life and livelihoods all over the world, as well as support governments in combating this unprecedented crisis in terms of health and the socioeconomic sector.

Finally, responding to the survey's objective, it is emphasized that the pandemic, by causing a serious global

² Available at: <https://g1.globo.com/ciencia-e-saude/noticia/2020/06/30/novo-virus-com-potencial-pandemico-achado-em-porcos-na-china-tem-elo-com-h1n1-que-causou-mortes-em-2009.ghtml>. Access on August 07, 2020.

health problem, also extending to a global economic crisis, has led the planet to a great recession that directly threatens the achievement of the objectives of Sustainable Development. Thus, it is up to Education, whether at a distance in this context of distance/social isolation, or even after this scenario in a classroom manner, to include an agenda of transversal contents on sustainability in the curriculums of all systems, modalities and spheres of education.

5. References

ANTUNES, Jeferson; NASCIMENTO, Verônica; QUEIROZ, Zuleide. Educação para sustentabilidade, interdisciplinaridade e as contribuições da mediação para a construção do conhecimento. **Revista do PPGEA/FURG-RS**, Rio Grande, v.35, n.1, jan./abr. 2018, p.260-278.

CARLETTTO, Marcia; LINSINGEN, Irlan; DELIZOICOV, Demétrio. Contribuições a uma educação para a sustentabilidade. In: I Congresso Iberoamericano de Ciencia, Tecnología, Sociedad e Innovación CTS+I, Cidade de México, 2006. **Anais [...]**.

CECCON, Roger Flores, & SCHNEIDER, Ione Jayce Ceola. **Tecnologias leves e educação em saúde no enfrentamento à pandemia da COVID-19**. FapUNIFESP (SciELO), doi:10.1590/scielopreprints.136, 2020.

HENRIQUE, Victor Hugo De Oliveira; GOEBEL, Larissa Gabriela Araujo (2020). **Diálogos entre a Educação Ambiental e a Gestão Escolar**. Geociências, Sociedade e Sustentabilidade, Editora Conhecimento Livre, doi:10.37423/200200302

FILHO, Astrogildo Luiz De França; ANTUNES, Charlles Da França; COUTO, Marcos Antonio Campos (2020). **Alguns apontamentos para uma crítica da EaD na educação brasileira em tempos de pandemia**. Revista Tamoios, 16(1), ISSN 1980-4490, Universidade de Estado do Rio de Janeiro, doi:10.12957/tamoios.2020.50535, 2020.

FILHO, Manoel Martins De Santana. **Educação geográfica, docência e o contexto da pandemia COVID-19**. Revista Tamoios, 16(1), ISSN 1980-4490, Universidade de Estado do Rio de Janeiro, doi:10.12957/tamoios.2020.50449, 2020.

GALLELI, Bárbara. **Organizações e sustentabilidade: educação para a sustentabilidade**. Organizações e Sustentabilidade, 7(1) (p. 3), ISSN 2318-9223, Universidade Estadual de Londrina, doi:10.5433/2318-9223.2019v7n1p3, 2018.

GIL, Antônio Carlos. **Como elaborar projetos de pesquisa**. 4.ed. São Paulo: Atlas, 2017.

GOES, Emanuelle Freitas; RAMOS Dandara de Oliveira; FERREIRA, Andrea Jacqueline Fortes.

Desigualdades raciais em saúde e a pandemia da COVID-19. **Trabalho, Educação e Saúde, 18(3)**, ISSN 1981-7746, FapUNIFESP (SciELO), doi:10.1590/1981-7746-sol00278, 2020.

MARTINS, Liziane; MIRANDA, Nathália Da Silva; LEAL, Clara Emanuelle Alves; DIONOR, Grégory Alves. Abordagem socioecológica na educação alimentar: um olhar para a alimentação e sustentabilidade. **Desafios da educação brasileira: impactos e perspectivas**, Editora Conhecimento Livre, doi:10.37423/200200294, 2020.

MIGUEIS, Claudia Maria. Educar para a sustentabilidade: princípios e práticas sustentáveis em escola estadual rural da região metropolitana do Rio de Janeiro. In: Congresso Nacional de Excelência em Gestão, 2014. **Anais [...]**.

OLIVEIRA, Wanderson; DUARTE, Elisete; FRANÇA, Giovanny; GARCIA, Leila. Como o Brasil pode deter a COVID-19. *Epidemiol.Serv.Saude*, v.29, n.2, Brasília, p.1-8, 2020.

RODRIGUES, Tayronne de Almeida; LEANDRO NETO, João; SILVA, Francisco Mário de Sousa. A Contribuição do Projeto Solari para a Educação da Juventude Campesina no Município de AssaréCE. **Id on Line Rev.Mult. Psic.**, vol.13, n.45 SUPLEMENTO 1, p. 302-317, 2019.

SAPIRO, Alexander; ANTONELLO, Ivan Carlos; GUILHERMANO, Luiz Gustavo. **Pandemia, Informações, Educação, Saúde e Mudança**. *Scientia Médica*, 30(1) (p. 38332), ISSN 1980-6108, EDIPUCRS, doi:10.15448/1980-6108.2020.1.38332, 2020.

SILVA, Valdenildo Pedro; PONTES, Julio Cesar (2020). **Educação para a sustentabilidade em currículos da educação básica**: implementação e desafios. *Brazilian Journal of Development*, 6(5) (pp. 30320-30330), ISSN 2525-8761, 2020.

An overview of the research and patenting activities that took place in Brazil during the 2010s

Vinicius Eduardo Ferrari (Corresponding author)

Center for Economics and Administration, Pontifical Catholic University of Campinas

Post-Graduation Program in Sustainability

1516, Professor Euryclides de Jesus Zerbini Street, Fazenda Santa Cândida, Campinas 13087-571, Brazil.

Corresponding author. Email: vinicius.ferrari@puc-campinas.edu.br

Maria Eduarda Carvalho de Araújo

Center for Economics and Administration, Pontifical Catholic University of Campinas. 1516,

Professor Euryclides de Jesus Zerbini Street, Fazenda Santa Cândida, Campinas 13087-571, Brazil

Samuel Carvalho De Benedicto

Center for Economics and Administration, Pontifical Catholic University of Campinas

Post-Graduation Program in Sustainability

1516, Professor Euryclides de Jesus Zerbini Street, Fazenda Santa Cândida, Campinas 13087-571, Brazil

Cândido Ferreira Silva Filho

Center for Economics and Administration, Pontifical Catholic University of Campinas

Post-Graduation Program in Sustainability

1516, Professor Euryclides de Jesus Zerbini Street, Fazenda Santa Cândida, Campinas 13087-571, Brazil

Abstract

A National Innovation System is an interconnected network of public and private institutions that aims at the development and diffusion of new technologies. We use the Derwent Innovations platform to study the patent applications in Brazil between 2010 and 2020, and to identify the main technological areas that have benefited from the research conducted in the country. Our main methodological contribution is to present indicators that measure the technological importance and international scope of Brazilian patents. The results show that private companies rarely resort to intellectual property protection mechanisms and that public universities are responsible for most patent applications. This study concludes that private companies innovate little, and, as a result, academic research tends to act as a substitute for business investments in research and development, especially in software development, pharmaceutical outputs, and scientific instrumentation. On the other hand, Brazilian universities and companies are both being excluded from the global race for the Internet of Things patents that has characterized the fourth industrial revolution.

Keywords: National Innovation Systems; Brazilian public universities; patents.

1. Introduction

A National Innovation System (NIS) is an interconnected network of public and private institutions that interact while aiming at the development and diffusion of new technologies (Nelson, 1993; Freeman & Soete, 1997). In developed countries, such interactions encompass three crucial elements. The private sector is primarily responsible for research and development (R&D) efforts related to the emergence of new marketable products and services, while academic institutions play a central role in generating basic scientific knowledge (Cohen, Nelson, & Walsh, 2002). Moreover, much of the technological innovations are funded by public research funds (Freeman, 1995).

The level of maturity of the NIS has a strong influence on the technological asymmetries between countries (Patel & Pavitt, 1994). This assumption raises concerns about the situation in Brazil. Although the country registers relevant scientific production in some areas, rarely the links between research institutions and private companies are strong enough to make a scientific invention reach the market as an innovative product (Dal Poz, 2006; De Negri, 2018).

The Brazilian NIS presents several distortions relative to the most technologically advanced countries. In these, the business sector leads investments in science, technology, and innovation (S&T&I), and also patent applications. In contrast, few companies in Brazil have developed internal R&D competences so that innovative efforts are limited mainly to the purchasing of machinery, equipment, and software. Consequently, public universities have been leading patent applications (Buainain et. al., 2019).

Several authors recognize the crucial role of Brazilian educational institutions in generating and transferring new technological knowledge to the business sector (De Negri, 2018; Buainain et. al., 2019; Garcia, Araújo, Mascarini, Santos, & Costa, 2020; Suzigan, Garcia, & Feitosa, 2020). However, these studies have primarily focused on the structural factors that hinder university-company interactions, which ended up ignoring other relevant questions: what are the technological areas that Brazilian universities have prioritized in their latest research? How to assess the economic importance of patents derived from such research? What is the international scope of the patents granted to Brazilian educational institutions?

This paper intends to address these research gaps. For this matter, we use the platform *Derwent Innovations* to search for the patent applications filed at the Brazilian National Institute of Intellectual Property (NIPI) between January 2010 and April 2020. We then classified the patents by technological classes using the Derwent platform. The features provided by Derwent also enabled the computation of two patent indicators that were used to assess the technological importance of each intellectual property (IP) document.

The rest of this paper is organized as follows. Section 2 discusses the gaps in the Brazilian NIS. Section 3 describes the methodological procedures used to identify Brazilian patents and compute patent indicators. Finally, Section 4 describes the technological content of these IP documents, and Section 5 concludes the study.

2. Types of the National Innovation System and the specifics of the Brazilian case.

According to Freeman (1995), the studies conducted by German economist Friedrich List were precursors

to the concept of NIS. In the 19th century, List proposed the creation of a ‘national system for economic policy’, that is, the adoption of a set of economic measures to accelerate Germany’s technological development and debunk the UK’s industrial hegemony. Those public policies should include: i) commercial protection of new economic segments, ii) financing for the constitution of R&D departments in the companies; iii) foundation of universities and research institutes specialized in the transfer of technologies to the business sector.

These policies were successful and, already in 1870, chemical companies in Germany were quite ahead of those in the UK. Several other countries realized that success and decided to replicate the same public policies, which ended up causing a change in industrial development, in addition to the creation of new universities and research laboratories (Schacht, 1999).

Friedrich List’s pioneering contributions influenced the contemporary view on NIS. This concept comprises an interacting network composed of public and private institutions aimed at developing and disseminating new technologies (Nelson, 1993; Freeman & Soete, 1997). In dynamic NIS, such interactions encompass at least three key players: i) private companies that tend to support applied research activities aimed at developing new products, processes, and marketable services; ii) universities active in exploratory research capable of generating upstream inventions (Cohen et al., 2002); iii) public institutions for the financing of business and academic research.

In contrast to dynamic NIS, Patel and Pavitt (1994) also highlight the existence of short-sighted systems where their parts do not see the difference between technological investments and other types of entrepreneurial investments. This implies lower R&D spending when compared to mature systems. Thus, in “myopic NIS”, the connections between research institutions and private companies are not strong enough to have scientific inventions reach the market in the form of innovative products. The authors conclude that the degree of maturity of the NIS has strong influence on the technological asymmetries that exist between countries and on the effectiveness of public policies aimed at closing such gaps.

Several recent studies have emphasized the gaps in the Brazilian NIS. According to De Negri (2018), the credit sources currently available in Brazil are insufficient to finance scientific and technological development. In addition, investment in human capital and infrastructure in the country is lacking, and a regulatory environment favorable to research activities and collaborations between universities and companies is rarely observed. According to De Benedicto (2020) the existing bureaucracy in the academic environment limits the knowledge diffusion that could be transformed into new commercial applications. Moreover, historical resistance from the Brazilian business community to autonomous R&D programs exists. Such a trend was confirmed by the 2014 PINTEC/IBGE survey. Only 15% of the companies surveyed declared that internal S&T&I activities are important. Besides, PINTEC/IBGE also confirmed that innovative efforts are mainly restricted to ‘external R&D spending’, a euphemism for the acquisition of machinery and equipment (Buainain et. Al., 2019).

The level of maturity of the SNIs also seems to influence the culture of protection for the IP. In mature NISs, patents are seen as appropriability mechanisms capable of providing competitive asymmetries to companies in the cutting edge of innovation (Ferrari, Silveira & Dal Poz, 2019). However, in the Brazilian case, companies rarely innovate ‘in the areas in which they operate and few of them rely on intellectual property protection mechanisms’ (Buainain et. Al., 2019, p. 14).

3. Methodology

The platform chosen for carrying out patent searches was the *Derwent Innovations Index* – DII (Web of Science/ Clarivate Analytics). Derwent was accessed through the Capes Portal, which is available at <http://www-periodicos-capes-gov-br.ez128.periodicos.capes.gov.br/>. The survey covered the period extending from January 2010 to April 2020. Objectively, it sought patent registrations with the prefix ‘BR’ in their numbering, i.e., the prefix that indicates the IP documents granted or revalidated by the Brazilian NIPI. We then classified the patents by technological classes using the *Derwent Class Codes*. The features provided by *Derwent* also allowed us to compute two proxies for measuring technological importance of patent documents – the indicators for forward citations and patent families.

3.1 Forward citations

A methodological procedure frequently used to identify patents of high economic value consists of counting the number of later citations. According to Trajtenberg (1990), the citations that a patent receives from more recent ones represent a proxy regarding the technological importance of inventions disclosed on the patent that was cited. Similarly, Harhoff, Scherer, and Vopel (2003) found that the number of forward citations that a patent receives is positively correlated with the monetary value attributed to it by its inventors.

3.2 Size of patent families

A priority number is automatically generated when an inventor applies for a patent for the first time, which guarantees the assignee the exclusive right to apply for protection of the technology in other countries through extension patents for one year. Therefore, a single invention can be protected by its original patent and by its extension patents, forming a so-called patent family, that is, a set of IP documents that share the same priority number (Ferrari & Pacheco, 2020).

The size of a patent family is equivalent to the number of nations in which a specific invention has obtained patent protection. Whenever an original patent is extended, the inventor bears the filing and maintenance fees stipulated by the country responsible for revalidating the document. As emphasized by Harhoff, Scherer, and Vopel (2003), due to the additional costs generated by each reissue application, companies prioritize the extension of the most technologically solid patents that exhibit the greatest chance of generating royalties. Thus, the authors herein highlight the correlation between the size of a patent family and the monetary value attributed to the respective invention by its owners.

4. Results

The patent search identified 252,061 distinct patent families. In Brazil, approximately 80% of patent applications made during the 2010s were submitted by non-residents, the vast majority of cases being patents obtained by foreign companies in other countries that were subsequently revalidated by the NIPI. Thus, the ranking of the main patent holders in Brazil is led by seven US multinationals and five European conglomerates in addition to two Japanese and one Chinese company (Table 1).

Table 1. Top Brazilian Patents Holders (base of 252,061 patent families covering January 2010–April 2020).

TOP 15 Foreigner Assignees			TOP 15 National Assignees		
Assignee	General Ranking	Patents	Assignee	General Ranking	Patents
QUALCOMM INC (USA)	1	3892	USP UNIVERSITY OF SÃO PAULO	54	634
PHILIPS (Netherlands)	2	3012	UNICAMP STATE UNIVERSITY OF CAMPINAS	59	590
BASF (Germany)	3	2935	FEDERAL UNIVERSITY OF MINAS GERAIS	72	508
DOW (USA)	4	2914	PETROBRAS	74	504
GENERAL ELECTRIC (USA)	5	2785	FEDERAL UNIVERSITY OF RIO GRANDE DO SUL	79	468
HALLIBURTON ENERGY S (USA)	6	2463	FEDERAL INSTITUTE OF EDUCATION, SCIENCE AND TECHNOLOGY	100	359
BAYER (Germany)	7	1642	FEDERAL UNIVERSITY OF PARANA	103	355
HUAWEI (China)	8	1606	FEDERAL UNIVERSITY OF PARAIBA	187	211
3M (USA)	9	1506	FAPESP	218	186
SIEMENS (Germany)	10	1473	FEDERAL UNIVERSITY OF CEARA	229	179
SONY (Japan)	11	1439	VALE DO RIO DOCE CO.	265	163
JOHNSON (USA)	12	1414	TECHNOLOGY FEDERAL UNIVERSITY OF PARANA	294	145
HOFFMANN LA ROCHE (Switzerland)	13	1377	FEDERAL UNIVERSITY OF SERGIPE	308	140
TOYOTA (Japan)	14	1345	SEB AS	319	135
PROCTER & GAMBLE (EUA)	15	1294	FEDERAL UNIVERSITY OF PELOTAS	323	134

Source: Derwent Innovations Index – DII (Web of Science/Clarivate Analytics)

The Brazilian economy is the ninth-largest in the world, registering a GDP of 1.6 trillion dollars in 2019. The second-largest consumer market in the Americas has historically attracted the interest of the main global economic conglomerates. Thus, the efforts of foreign corporations listed in Table 1 – and many other multinationals that were not shown in the same table due to the lack of space – in protecting their technological assets in Brazil have transformed the country into an important stage for the patent races that have characterized the economic segments where such transnational companies operate (e.g. chemical, pharmaceutical, computing, and automobile).

In contrast, Brazilian corporations stayed out of the technological races that characterized the decade of 2010. As shown in Table 1, Petrobras is the only business company to appear in the ranking of the top 100 Brazilian patent holders. In the Brazilian case, public universities were responsible for most patent applications made to the NIPI by residents. This situation differs completely from that in developed

countries, where a certain balance between applications made by residents and non-residents exists, and the domestic business sector leads patent filings.

Such evidence suggests that academic research in Brazil tends to assume a greater role in the NIS when compared to developed countries, thus justifying a deeper study of the technological relevance of university patents. However, a remark must be made. Simply counting patents filed by universities, as shown in Table 1, ignores the strongly asymmetric nature of patent documents. A few rare patents are economically relevant and represent significant technological developments. In contrast, most patented technologies are not embodied in commercial applications (Trajtenberg, 1990).

As emphasized in Section 3, counting forward citations is a methodological device often used to identify the most technologically relevant IP documents (Hall, Jaffe, & Trajtenberg, 2001). By adopting this procedure, the present study found that only six Brazilian universities have patents that were referred to by younger ones. Table 2 shows that the highly cited patents belong mainly to the University of São Paulo (USP), the State University of Campinas (UNICAMP), and the Federal University of Minas Gerais (UFMG).

Table 2. Data on Brazilian university patents that received forward citations and/or have been revalidated in other countries.

UNIVERSITY	Forward Citations				Extension Patents		
	At least 1 citation	At least 5 citations	At least 10 citations	Most cited patent	Patents revalidated at USPTO and EPO	Revalidated in at least 5 countries	Revalidated in at least 10 countries
UNICAMP	105	12	9	17	16	15	1
USP	47	7	1	28	13	9	2
UFMG	97	9	3	21	22	19	3
UNIVERSITY OF RIO GRANDE DO SUL	35	5	0	7	10	5	5
UNIVERSITY OF PARANA	3	1	0	8	3	3	0
UNIVERSITY OF PARAIBA	1	0	0	1	0	0	0

Source: Derwent Innovations Index – DII (Web of Science/Clarivate Analytics)

The analysis of the extension patents complements the previous analysis on forward citations. Column 6 of Table 6 adds up the number of Brazilian university patents that have been revalidated by both the United States Patent and Trademark Office (USPTO) and the European Patent Office (EPO). Due to the predominance of these markets in the commercialization of technological products, thousands of inventors from other countries have shown strong interest in protecting their inventions in the US and Europe (Hall, Jaffe, & Trajtenberg, 2001).

However, Brazilian universities do not follow this global trend. Only 64 out of 3,858 university patent

families registered in Column 4 of Table 1 contain both North American and European extension patents. Therefore, most patent families have their validity restricted to Brazilian geographic territory, which makes difficult to commercialize the technologies developed by Brazilian universities in other countries and, at the same time, to transfer these inventions to the business sector through licensing agreements. Besides, extension patents are concentrated in only 3 institutions: USP, UNICAMP, and UFMG (Table 2).

We use the *Derwent Class Codes* (DCC) to technologically compare the Brazilian patents owned by foreign companies with the IP documents belonging to UNICAMP, USP, and UFMG. In practical terms, the cell color scheme in Table 3 shows whether the technologies described in Column 2 are part (columns in yellow) or not (columns in white) of the Top 15 technological classes that received the most patent applications from the institutions listed in Line 1. Furthermore, the numerical values in the cells show the position of each technology in such rankings.

Table 3 highlights the interest of foreign companies in protecting the applications related to the Internet of Things (IoT) in Brazil. This concept refers to a series of complementary technologies that digitally enable inanimate objects to collect and share data with each other, perform new functions, and improve their performance (Atzori, Iera, & Morabito, 2010). Class W01, which includes networked data transmission and sharing systems, had the second-largest number of patent applications made by foreign companies, due in part to the fact that the world's leading IoT solutions company – QUALCOMM INC – also occupies the position of the principal owner of Brazilian patents (Table 1). In contrast, Brazilian companies and universities do not even appear on the IoT patent map and in technological applications for electric cars (class X22).

The same perspective did not occur in the case of technologies related to the oil/gas sectors (class H01, 8th in the ranking of foreign companies) and mining (class Q49, 10th in the ranking of foreign companies). The patents granted to the universities listed in Table 3 did not prioritize such economic segments. Nevertheless, Brazilian companies Petrobras and Vale do Rio Doce have developed solid research and patenting skills in technological fields covered by classes H01 and Q49.

On the other hand, unlike the giants Petrobras/Vale do Rio Doce and the main foreign corporations operating in Brazil, UNICAMP, USP, and UFMG directed a significant portion of their patent applications to more traditional economic segments, such as the food industry (class D13), the sectors producing cosmetics and disinfectants (class D22), and basic sanitation services (class D15).

Table 3. Ranking the Top 15 Derwent Class Codes (DCC) that received most patent applications: i) aggregated portfolio of IP documents belonging to the top 100 foreign holders of Brazilian patents; ii) portfolios from UNICAMP, USP, and UFMG.

DCC	Description	Ranking DCC – foreign holders	Ranking DCC UNICAMP	Ranking DCC – USP	Ranking DCC – UFMG
T01	Digital computers, data processors, interfaces, and program control	1	4	8	9
W01	Communication: data transmission systems and data networks	2			
D16	Microbiology and fermentation	3	2	2	2

A96	Medical, dental, veterinary, cosmetic derived from polymers	4	5	3	3
B04	Pharmaceuticals or veterinary compounds	5	1	1	1
W02	Communication: broadcasting, radio, and line transmission systems	6			
A97	Papermaking, detergents, food and oil derived from polymers	7	14	15	11
H01	Petroleum	8			
S03	Scientific instrumentation	9	3	4	4
Q49	Mining constructions	10			
D21	Preparations for dental or toilet purposes	11	8	5	
W04	Audio/video recording and systems	12		10	
P31	Diagnosis, surgery	13			
X22	Electric power engineering – automotive	14			
S05	Electrical medical equipment	15	15	9	10
D13	Foodstuffs and animal feed		6	12	
J04	Chemical engineering		7	13	7
B07	General: tablets, dispensers, catheters		9	6	5
B05	Pharmaceuticals: aromatics, aliphatic, organo-metallics		10	7	6
J01	Evaporation, crystallisation, chromatography, dialysis, and osmosis		11		
D22	Cosmetics and disinfectants: sterilising, bandages, skin-protection agents		12		15
D15	Treating water, industrial waste, and sewage		13		14
P32	Dentistry and prosthesis			11	
A89	Photographic, laboratory equipment, optical			14	12
C06	Biotechnology: including plant genetics and veterinary vaccines				8
B02	Pharmaceuticals: fused ring heterocyclics.				13

Source: Derwent Innovations Index – DII (Web of Science/ Clarivate Analytics)

Notwithstanding the differences in the previous three paragraphs, the present study found several points of similarity between the institutions presented in Table 3. Rows 2–11 in the table show the ten technological classes with more patents from foreign companies. The predominance of yellow in these rows suggests a

certain technological convergence between such transnational corporations and Brazilian universities. The technological classes that include software development (class T01), microbiology and fermentation (class D16), production of pharmaceutical drugs and veterinary products (classes A96 and B04), paper and cellulose (class A97), scientific instrumentation, and hospital equipment (classes S03 and S05) were highlighted in all the research programs in Table 3.

Technological convergence proved to be even stronger among the three Brazilian universities. The patenting activities of UNICAMP, USP, and UFMG have mainly prioritized the same DCCs. This study identifies only three individual exceptions (i.e. three exclusive classes): UNICAMP has favored the chemical processes for separating organic compounds (class J01) while USP has developed technologies in the field of dentistry (class P32). Furthermore, UFMG has shown interest in researching new plant biotechnologies (class C06).

5. Conclusions

The findings of this study tend to reinforce two propositions present in Buainain et al. (2019). The authors had already verified the leadership of Brazilian universities in patent applications made by residents and the absence of domestic companies in the worldwide patent race that has involved several contemporary economic segments. Our results demonstrate that Brazilian inventors are also not participating in the global race for IoT applications, which further increases the risk that Brazilian companies and universities will be entirely excluded from the fourth industrial revolution.

On the other hand, the evidence presented here does not support the proposition that Brazilian universities' patenting activities are more linked to the 'old economy' (Buainain et. al. 2009). Several points of technological convergence were identified between UNICAMP, USP and UFMG, and the group formed by the top 100 foreign holders of Brazilian patents. In both cases, a significant portion of the patent filings was directed to software development, microbiology, pharmaceutical outputs, and scientific instrumentation. Hence, our results seem to be in line with those of Garcia, Araújo, Mascarini, Santos, & Costa (2020) according to which, owing to the lack of private R&D efforts in Brazil, academic research tends to act as a substitute for business investments in S&T&I, which contributes to direct university activities towards applied research.

Finally, the original contribution of this work is in determining that most university patent families have their legal validity restricted to the Brazilian geographic territory. We emphasize that this situation could potentially: i) hinder commercial exploitation in other countries of technologies developed by Brazilian universities; ii) restrict the diffusion of these inventions to the business sector through licensing agreements; iii) limit the royalty revenues derived from such contracts. However, these proposals must be confirmed by specific studies on technology transfer agreements signed between Brazilian universities and private companies.

6. Acknowledgment

We are grateful to Pontifical Catholic University of Campinas (PUC Campinas) for its support to this research and to Brazilian National Council for Scientific and Technological Development (CNPq) for granting a PIBIC fellowship to Maria Eduarda Carvalho de Araújo.

7. References

- Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. *Computer Networks*, 54(15), 2787–2805. <https://doi.org/10.1016/j.comnet.2010.05.010>.
- Buainain, A. M.; Souza, R. F., Ferrari, V. E., Vieira, A. C. P., Bueno, C. S., & Sabino, W. (2019). *Propriedade intelectual e desenvolvimento no Brasil*. 1. ed. Rio de Janeiro: Ideia D; ABPI
- Cohen, W. M., Nelson, R. R., & Walsh, J. P. (2002). Links and Impacts: The Influence of Public Research on Industrial R&D. *Management Science*, 48(1), 1–23. <https://doi.org/10.1287/mnsc.48.1.1.14273>.
- Dal Poz, M. E. S. (2006). *Redes de inovação em biotecnologia: genômica e direitos de propriedade intelectual*. Tese de Doutorado em Política Científica e Tecnológica - Instituto de Geociências, Universidade Estadual de Campinas.
- De Benedicto, S. C. (2020). *Produção e transferência de (eco)tecnologias em universidades brasileiras*. Curitiba: Appris, 2020.
- De Negri, F. (2018). *Novos caminhos para a inovação no Brasil*. Washington, DC: Wilson
- Ferrari, V. E., Silveira, J.M.F.J., & Dal-Poz, M. E. S. (2019). Patent network analysis in agriculture: A case study of the development and protection of biotechnologies. *Economics of Innovation and New Technology*, 1–23. <https://doi.org/10.1080/10438599.2019.1684645>
- Ferrari, V. E., & Pacheco, M. N. (2020). Propriedade intelectual e inovações tecnológicas na indústria de sementes: Discussões sobre os conflitos judiciais entre a Monsanto e os agricultores brasileiros. *Revista de Estudos Sociais*, 21(43), 89–103. <https://doi.org/10.19093/res9024>. [3]
- Freeman, C (1995). The ‘National System of Innovation’ in historical perspective. *Cambridge Journal of Economics*, v. 19, n. 1, p. 5–24.
- Freeman, C., & Soete, L. (1997). *The Economics of Industrial Innovation*. MIT Press.
- Garcia, R., Araújo, V., Mascarini, S., Santos, E. G., & Costa, A. R. (2020). How long-term university-industry collaboration shapes the academic productivity of research groups. *Innovation*, 22(1), 56–70. <https://doi.org/10.1080/14479338.2019.1632711>.
- Hall, B. H., Jaffe, A. B., & Trajtenberg, M. (2001). *The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools* (Working Paper No. 8498). <https://doi.org/10.3386/w8498>.

Harhoff, D., Scherer, F. M., & Vopel, K. (2003). Citations, family size, opposition and the value of patent rights. *Research Policy*, 32(8), 1343–1363. [https://doi.org/10.1016/S0048-7333\(02\)00124-5](https://doi.org/10.1016/S0048-7333(02)00124-5).

Nelson, R. R. (1993). *National Innovation Systems: A Comparative Analysis*. Oxford University Press.

Patel, P., & Pavitt, K. (1994). Uneven (and Divergent) Technological Accumulation among Advanced Countries: Evidence and a Framework of Explanation. *Industrial and Corporate Change*, 3(3), 759–787. <https://doi.org/10.1093/icc/3.3.759>.

Schacht, H. (1999). *Setenta e seis anos de minha vida*. Editora 34.

Suzigan, W., Garcia, R., & Feitosa, P. H. A. (2020). Institutions and industrial policy in Brazil after two decades: Have we built the needed institutions? *Economics of Innovation and New Technology*, 0(0), 1–15. <https://doi.org/10.1080/10438599.2020.1719629>.

Trajtenberg, M. (1990). A Penny for Your Quotes: Patent Citations and the Value of Innovations. *The RAND Journal of Economics*, 21(1), 172–187. <https://doi.org/10.2307/2555502>

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/>).

Promotion of the quality of life of workers in a higher education institution: a scope review

**Isaura Sousa, Márcia Teles, Tatyanne Rodrigues, Fernando Lopes Silva-Júnior, Ana Maria
Ribeiro, Fernanda Avelino**
Universidade Federal do Piauí
Brazil

Abstract

The present study aimed to map the evidence to provide an overview of actions implemented/executed and scales used in public higher education institutions to promote worker health. A scoping review based on the PCC (Population, Concept, and Context) mnemonic was conducted in PubMed, CINAHL, Scopus and Virtual Health Library (VHL). Population included workers from a higher education institution, the concept referred to studies focusing on the assessment of quality of life and health promotion actions and the context to higher education institutions. Electronic searches were held on December 2019. A qualitative synthesis of the data extracted from included studies (i.e. author, year, study design, sample, country, aims, action implemented/performed, thematic focus, evaluation) was performed. Electronic searches retrieved 3,330 articles that were screened by titles and abstracts. Of these, 34 studies were fully appraised, of which four reported that actions implemented/executed related to sedentariness, posture and stress. The studies show 49 scales were identified to measuring at least one quality of life item. Through this scoping review the available evidence to provide an overview of actions implemented/executed and scales used in public higher education institutions to promote worker health. Future studies should consider more rigorous designs and objective measures to measure the quality of life of these professionals, and develop target interventions based on factors associated with the work. It is also necessary to evaluate whether the strategies work.

Keywords: Health Promotion; Occupational Groups; Occupational Health; Quality of life; Universities; Vocational rehabilitation

1. Introduction

Quality of life, although there is no consensual definition about its true meaning, for the World Health Organization (WHO) it is the individual's perception of their insertion in life, related to the culture and values in which they live, involving objectives, expectations, standards and concerns.[1] It represents the degree of satisfaction found in family, loving, social and environmental life and existential aesthetics, which reflect knowledge, experiences and values that are reported to him in different times, spaces and different stories.[2]

The quality of life at work is a factor that involves living conditions in the work environment, such as well-being, health guarantee, physical security, monthly, social and ability to perform tasks and good use of personal energy.[3]

Developing instruments for assessment of quality of life psychometrically valid is a difficult activity, becoming a challenge for researchers.[4] However, the issue of quality of life has increased in recent years, not only in conducting research, but also in the translation and validation of instruments.[5]

Worker health is directly linked to employee performance and productivity[6], therefore, the institutions responsible for the worker must encourage the development of actions that enable organizations to fully achieve their missions.[7]

By improving working conditions, institutions will be promoting physical and mental health, both individual and organizational.[3,6] The focus of studies on workers' quality of life is on musculoskeletal disorders, psychological and behavioral disorders, as well as interventions for older employees and economic assessments.[6]

Programs for quality of life at work and general quality of life are the main strategies that the institution must develop in order to achieve professional satisfaction and improve the quality of the service offered by the worker. The preventive culture is fundamental, which should be the responsibility of both, the worker and the employee.[7]

In this context, the technical-scientific advancement allows the emergence of actions and technologies to assist to assist in the promotion of workers' health, which must be the result of processes implemented based on daily experiences directed to the methodical development of knowledge and knowledge to be used for the purpose specific practice. Therefore, it is understood that the use of these strategies enhances health promotion directed at the worker.

In view of this scenario, a scope review was carried out, guided by the methodology proposed by the Joanna Briggs Institute (JBI)[8], with the aim of map the available evidence to provide an overview of the actions implemented/ performed, as well as the health assessment instruments used in public higher education institutions to promote worker health.

This review aims to answer the following questions: What actions are implemented/ performed to promote the quality of life of workers in the higher education institution? What instruments for assessing health and quality of life are available for workers in a high education institution?

2. Methods

It is a scope review, which intends to map the available evidence broadly on some topic, which can be conducted to identify the main concepts or evidence related to an established research area, and to understand the definitions / conceptual limits.[9]

The scope review framework was developed from the Joanna Briggs Institute (JBI) approach to conducting this type of review[10], which described the following stages: definition and alignment of the objective (s) and question (s); development and alignment of inclusion criteria with the objective (s) and question (s); description of the planned approach to research, selection, extraction and creation of evidence; search for

evidence; extraction of evidence; trace of evidence; summary of the evidence in relation to the objective (s) and question (s); consultation with information scientists, librarians and/ or experts.

The elaboration of the research question was based on the “PCC” strategy, in which “P” refers to the study population (workers from a higher education institution); “C” to the studied concept (studies focusing on the assessment of quality of life and health promotion actions); “C” to the context that is inserted (all higher education institutions).[9]

The search strategy and the study preparation process was based on the scope review methodology proposed by JBI[8], which describes three steps: 1. Initial research limited to PubMed/ MEDLINE, CINAHL, Scopus and Virtual Health Library (VHL) to identify articles on the subject, followed by the analysis of the words contained in the titles and abstracts and, the index terms used to describe the articles; 2. Second search using all keywords and indexing terms identified in the included databases; 3. Analysis of the references of all articles and reports found in the research to identify additional studies. The search for unpublished studies included: Google scholar, and banks of dissertations and various doctoral thesis.

The descriptors and keywords used in the search strategies, with the Boolean connectors AND and OR were: “Workers”, “Quality of life”, “Health Promotion”, “Occupational Health”, “Universities”, “Faculties”, adapted for each research source. They are available to be checked if it is necessary.

Studies written in some language were considered for inclusion in this scope review, regardless of the year of publication. To guarantee the broad search, the access was through the periodical portal of the Coordination for the Improvement of Higher Education Personnel (CIHEP), in an area with *Internet Protocol* (IP) recognized at the Federal University of Piauí.

The data were extracted from the documents included in the scope review by two independent reviewers, using a standardized data extraction tool, adapted from the tool proposed by the Joanna Briggs Institute⁸. The extracted data included details on: population, concept, context, methods and results of significance for the scope analysis question.

In cases of doubt about the relevance of a study based on the abstract, the full version of the text was analyzed. The reviewers independently examined the full text of the articles to see if they met the inclusion criteria. Disagreements between reviewers were resolved through discussion or by a third reviewer.

The data extraction tool draft was modified and revised as needed during the data extraction process for each included study. When the results of the same study were reported in more than one article, only one was included. The entire study selection process, as well as the last search took place during the period from September to December of 2019.

There was no need for submission to the research ethics committee, as it does not involve human beings. As this is a scope review, it is not necessary to assess the methodological quality of the included studies.

This study followed the standards for excellence in quality improvement reports - Standards for Quality Improvement Reporting Excellence 2.0 (SQUIRE 2.0)[11], and was guided according to the scope review items checklist - Preferred Reporting Items for Systematic Reviews and Meta-Analyses extensions for Scoping Reviews (PRISMA-ScR) Checklist. PRISMA-ScR consists of a roadmap to guide the writing of the scope review report, consisting of 22 items divided into the mandatory chapters of the review report: Title, Summary, Introduction, Method, Results, Discussion and Funding.[12]

3. Results and discussion

The search in the databases raised a total of 3,343 studies. After deleting the 13 duplicate citations, the titles of 3,330 documents were read to verify compliance with the inclusion criteria. Of these, 41 studies were selected for reading the abstracts and, subsequently, 34 were read in full. All 40 texts read in full met the inclusion criteria and met the objectives. The search strategy is represented in Figure 1.

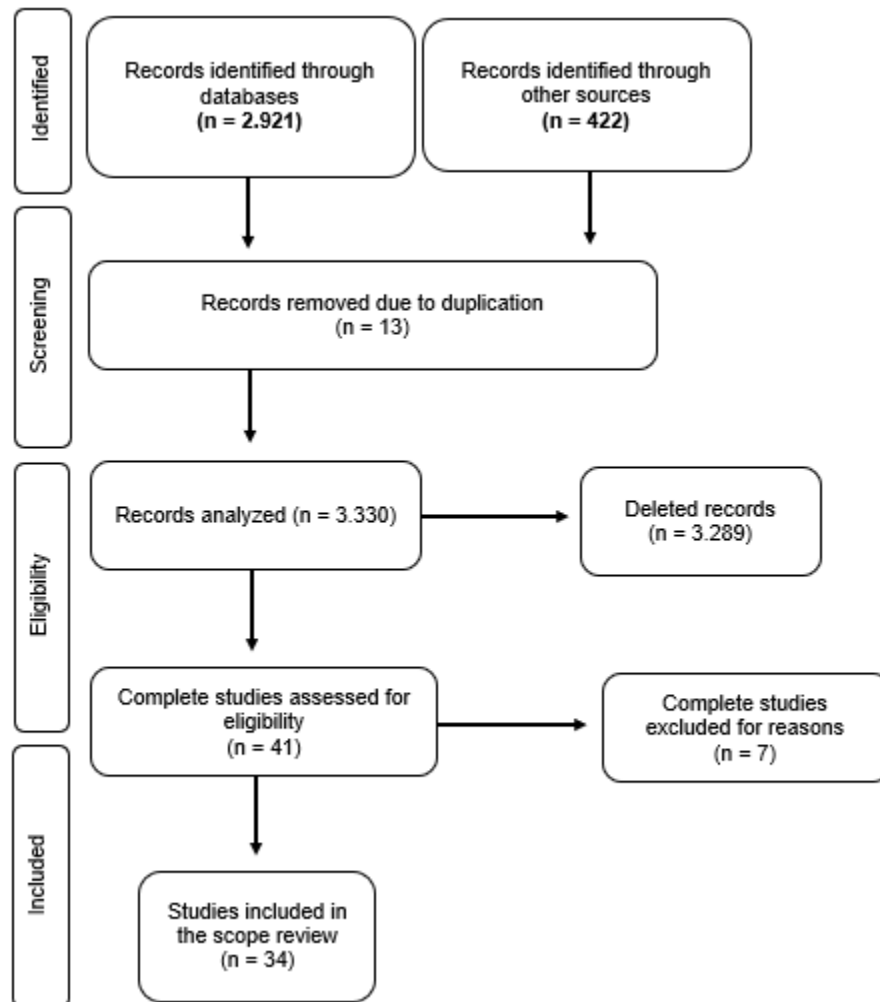


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2009 Flow Diagram.

Six studies were excluded because they did not address the target population defined for this work. One study was excluded due to lack of access to the full text and the author's lack of response.

Among the studies included, four were published in nursing journals, fifteen in interdisciplinary health journals, ten in journals from other health areas (psychology, medicine, physiotherapy and nutrition), five in journals from other areas (social sciences, education, administration and economy). It stands out that, all the studies retrieved in magazines from different health areas, are the results of the search carried out in the gray literature.

Thirty-four studies were selected for analysis, twelve in Scopus, nine in Google Scholar, seven in MEDLINE by PubMed, five in the VHL and one in CINAHL. Regarding the language, twenty-three were in English, eight in Portuguese, two in Spanish, and one in Persian.

Regarding the professional category of the authors, five studies were written only by nurses, nine by professionals from more than one type of training, four only by doctors, three only by physical educators, five only by psychologists, two only by nutritionists, one only by economists. In five publications it was not possible to identify this information.

The primary studies were distributed in nine different countries: Australia (02), Brazil (11), Caribbean (01), China (01), Ecuador (01), Spain (02), United States (02), Ethiopia (01), Finland (01), India, Iran (04), Japan (01), Nigeria (01), Poland (01), Portugal (01), United Kingdom (03). The characteristics of the included studies are detailed below, as shown in Table 1.

Table 1. Included studies, according to type of study and country, as indicated in the original articles.

Authors (year)	Study design/sample	Country of author
Adewale & Anthonia (2013)	Cross-sectional study (n=237)	Nigeria
Ataro et al (2018)	Comparative cross-sectional study (n=60)	Ethiopia
Barzoki & Sarand (2015)	Descriptive study (n=120)	Iran
Biernat (2015)	Randomized study (n=373)	Poland
Blanch (2014)	Empirical study, mixed approach (n=722)	Spain
Brown & Sargeant (2007)	Cross-sectional study (n=263)	Caribbean
Cacciari et al (2016)	Cross-sectional study (n=92)	Brazil
Cacciaria et al (2017)	Cross-sectional study, descriptive-exploratory quantitative approach (n=92)	Brazil
Ciconato et al. (2016)	Cross-sectional study, descriptive quantitative approach (n= 92)	Brazil
Dewitt et al. (2019)	Uncontrolled intervention study with a mixed approach (n=29)	United Kingdom
Dias et al. (2018)	Descriptive study (n=965)	Brazil
Edwards et al. (2009)	Uninformed (n=2136)	United Kingdom
Kinman (2008)	Cross-sectional study (n=465)	United Kingdom
Gillespie et al. (2010)	Longitudinal research study (n=?)	Australia
Godinho et al. (2016)	Cross-sectional study (n=600)	Brazil
Gomes (2013)	Quantitative (n=635)	Portugal
Häfele et al. (2018)	Observational and cross-sectional study (n=371)	Brazil
Hafiz; Chouhan (2015)	Cross-sectional study (n=40)	India
Headley et al. (2018)	Cross-sectional, descriptive-exploratory study with a quantitative approach (n=127)	United States of America

Hosseini-Delshad; Sadat-Tavafian; Kazemnejad (2019)	Cross-sectional study (n=420)	Iran
Lee et al. (2009)	Descriptive and correlational cross-sectional study (n=145)	China
Mainenti et al. (2014)	Cross-sectional study (n=15)	Brazil
Montero-Marín et al. (2011)	Cross-sectional study (n=409)	Spain
MoreiraI et al. (2018)	Cross-sectional and descriptive study (n=40)	Brazil
Nespeca; Cyrillo (2010)	Cross-sectional exploratory study (n=276)	Brazil
Ortiz; Marziale (2010)	Descriptive, cross-sectional, non-experimental study with a quantitative approach (n=134)	Ecuador
Radas et al. (2013)	Randomized control study (n = 60)	Australia
Robazzi et al. (2019)	Descriptive, cross-sectional study with a quantitative approach (n=69)	Brazil
Sadeghian; Raei; Amiri (2014)	Prospective cohort study (n=182)	Iran
Scarpato; Amaro; Oliveira (2010)	Cross-sectional study with a qualitative approach (n = 130)	Brazil
Shojaei; Khazaei (2013)	Analytical study (n =?)	Iran
Tiainen; Ropponen; Louhevaara (2014)	Quasi-experimental and longitudinal field study (n = 181)	Finland
Tounaka et al. (2014)	Uninformed (n=163)	Japan
Veeranki; Mamudu; He (2013)	Descriptive cross-sectional study (n=1.414)	United States of America

Among the 34 primary studies included, only four implemented / performed any action to promote the quality of life of workers in the higher education institution: delivery of educational material at the service, development of behavior change strategies selected by the worker himself, a Erggi action model and, tool to deal with environmental stress (Table 2).

Table 2. Implemented/performed action to promote the quality of life of workers in the education institution.

Study	Aims of the study	Action implemented/performed	Thematic focus	Evaluation
Radas et al. (2013)	To determine if the education of office workers, along with adjustable workstations, leads to a reduction in sitting behavior.	Educational material + adjustable table	Sedentary lifestyle	NO
Dewitt et al. (2019)	To identify barriers and facilitators to reduce sitting and increase standing among office workers who have received an intervention prototype	Height-adjustable seat and bookcase + orientations	Sedentary lifestyle	(+)
Tiainen; Ropponen; Louhevaara (2014)	To investigate musculoskeletal symptoms and working conditions at the university with and without contact with an Erggi action model.	Erggi action model	Posture	(+)
Kinman (2008)	To examine the relationship between specific job stressors and psychological and physical symptoms in UK university workers	Stress management from the Sense of Coherence (SOC) in the work stress process	Stress	(+)

Legend: NO = was not shown; (+) = was evaluated; (-) = was not evaluated.

The objective of this scope review was to map studies focused on promoting the quality of life of workers in higher education institutions, also addressing the means of assessing quality of life used in the studies. To achieve these objectives, 34 studies were included in this work. Although the inclusion of studies in this review did not delimit the year or publication, the included research was published after 2007 and in several international settings, which indicates that the scientific and professional community needs to analyze such activities developed and instruments used due to the possibility of promote health and reduce possible risks to quality of life.

Several of the worker's health care initiatives have among their goals, to act in areas that impact the quality of life of the worker, being able to carry out strategies for the promotion of health in the future. In this sense, four actions were implemented / implemented in higher education institutions and 49 different instruments for assessing at least one item of measurement of quality of life. In addition, 19 studies used tools and instruments that were not validated, but developed for the research.

In this review, the actions implemented / performed to promote the health of workers from a higher education institution in the work environment were focused on physical inactivity[13,14], posture[15], and stress.[16]

One of the studies[13], of the randomized control type, divided the sample into three groups, among which, an intervention group received educational material on ergonomic measures, such as posture and physical activity. The other intervention group besides the material, received an adjustable table for the work and, the control group did not receive any intervention. For the authors, this type of action implemented in the institutions may reduce the prolonged permanence of time in the sitting position during work. However, no reports were found after this study concluding the effectiveness of the strategy adopted at the researched university.

In an uncontrolled intervention study[14] it was possible to observe in 12 weeks the reduction of the sitting time (to 3h14min) by the workers based on the strategy implemented adapting the workplace, with a table and an adjustable bookcase. The authors recommend the intervention, as it has increased awareness of “feel less, move more”, both in the workplace and elsewhere. They also mention that in the future they will implement the strategy as an online module for training personnel, thus facilitating the training of workers. In a survey carried out by a group of specialists, a recommendation was proposed to avoid prolonged sedentary work times, where the worker remains seated. The initial guidance is that these employees perform two hours of standing activities daily, performing a light walk, and after a few weeks with the change, progress to four hours daily.[17]

The Erggi action model was implemented as an education strategy for university workers.[15] This model consists of health promotion in the workplace based on the education of volunteers from the institution, called Erggi, who had previously taken a basic course in ergonomics. The teaching addresses advice on ergonomics, such as adjusting or purchasing office furniture, and maintaining good posture. The authors stated that the strategy increased the identification of musculoskeletal symptoms and knowledge about good ergonomics, thus reducing the need for sick leave.

Other study made use of the sense of coherence (SOC) construct to assess coping with environmental stressors, which consequently favors the permanence of health, both psychological and physical. According to the authors, people with a stronger SOC see life as more understandable, meaningful and manageable, which helps to deal with stressful situations.[16]

The SOC tool, together with improvement through primary interventions can combat work stressors.[16] According to the recommendations of Antonovsky (1991)[18], personal development and participation in decision making are factors that can increase the perception of these stressors that harm health.

Although knowledge about the beneficial effects of interventions directed to promoting work capacity and preventing workers' illnesses, few programs focused on health and well-being are still observed.[19]

Regarding the assessment instruments, the selected studies used 49 different types, among which general aspects of quality of life were assessed[16,20,21,22,23,24], musculoskeletal symptoms[13,15,21,22], physical activities[13,14,16,25,26,27,28], well-being[29,30], stress[20] and, related to the place and functioning of the work.[28,29,30]

Quality of life is assessed in general and globally using two main instruments: SF 36 (Medical Outcomes Study 36- item short- form health survey)[5,31] and the Whoqol (World health organization quality of life).[5] Both were used in the selected studies and were able to assess quality of life in a broad way. Authors also recommend WRQoL as a multidimensional and one-dimensional measure to assess the quality of professional life of employees in a higher education institution.[24]

Physical activity and exercise is effective intervention in the workplace to improve body posture, providing benefits for worker health.[19] Although the increase physical activity at work is not easy, an educational offer to employers on healthy lifestyle, leisure planning and behavior change strategies will considerably improve quality of life.[26]

Studies describe the benefits of a sense of well-being at work, which is related to the valuation, performance and quality of life of the worker at the institution[29] and, allows you to work more and better.[30]

The work environment must be organized in such a way that interaction between employees and managers takes place to improve personal relationships, as it can improve work capacity and, perhaps, prevent early retirement, which has a social and economic impact in Brazil.[28] In addition, it helps people deal with stress during work.[32]

4. Conclusion

Investing in quality of life at work, with the aim of improving function and increasing benefits, was considered necessary in the studies selected for analysis. And although, the fact that only actions implemented / executed were identified in only four articles, all the remaining thirty, after results, recognized the importance and suggested strategies for promoting worker health.

Therefore, investigating the quality of life of workers and the factors that interfere, such as physical inactivity, stress, personal relationships and beliefs, is crucial for maintaining health in institutions. Greater engagement of employee in the search for health promotion of workers is recommended, taking into account the assessment carried out using validated instruments.

6. Acknowledgement

This research received no specific grant from any funding agency in the public, commercial, or not-forprofit sectors.

7. References

[1] World Health Organization. "The World Health Organization Quality of Life Assessment (WHOQOL): position paper from the World Health Organization", Social science and medicine. 1995; 41(10), pp. 403-409.

- [2] M.C.S. Minayo, Z.M.A. Hartz, P.M. Buss, "Quality of life and health: a necessary debate," *Ciência & Saúde Coletiva*, 2000, 5(1), pp. 7-18.
- [3] A.S. Aquino, A.C.P. Fernandes, "Quality of work life," *Journal of the Health Sciences Institute*, 2013, 31(1), pp. 53-8.
- [4] M.P.A. Fleck, "The World Health Organization instrument to evaluate quality of life (WHOQOL-100): characteristics and perspectives," *Revista Ciência e Saúde Coletiva*, 2000, 5(1), pp. 33-38.
- [5] G.M.B. Landeiro, C.C.R. Pedrozo, M.J. Gomes, E.R.A. Oliveira, "Systematic review of studies on quality of life indexed on the Scielo database," *Ciência & Saúde Coletiva*, 2011, 16(10), pp. 4257-4266.
- [6] C. Pieper, S. Schröer, A.L. Eilerts, "Evidence of Workplace Interventions - A Systematic Review of Systematic Reviews," *International Journal of Environmental Research and Public Health*, 2019, 16(19), pp. 3553.
- [7] M.M. Osaki, M. Pustiglione, "Proposal of a methodology for actions in the area of quality of life at work in health services," *Revista de Administração em Saúde*, 2019, 19(74), pp. 5-19.
- [8] E. Aromataris, Z. Munn, Joanna Briggs Institute Reviewer's Manual: The Joanna Briggs Institute. Available from <https://reviewersmanual.joannabriggs.org/>, 2017.
- [9] M.D. Peters et al., Joanna Briggs Institute Reviewer's Manual: The Joanna Briggs Institute. Available from <https://reviewersmanual.joannabriggs.org/>, 2017.
- [10] M.D.J. Peters et al., "Guidance for conducting systematic scoping reviews," *International Journal of Evidence-Based Healthcare*, 2015, 13(3), pp. 141-46.
- [11] G. Ogrinc et al., "SQUIRE 2.0 (Standards for Quality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process," *J Nurs Care Qual*, 2016, 31(1), pp. 1-8.
- [12] H. Pham et al., "A scoping review of scoping reviews: advancing the approach and enhancing the consistency," *Research Synthesis Methods*, 2014, 5(1), pp. 371-385.
- [13] A. Radas et al., "Evaluation of ergonomic and education interventions to reduce occupational sitting in office-based university workers: study protocol for a randomized controlled trial," *Trials*, 2013, 14, pp. 330.
- [14] S. Dewitt et al., "Office workers' experiences of attempts to reduce sitting-time: an exploratory, mixed-methods uncontrolled intervention pilot study," *BMC Public Health*, 2019, 19:819, pp. 1-10.
- [15] S. Tiainen, A. Ropponen, V. Louhevaara, "A Quasi-Experimental Study of the Effects of the Erggi Action Model of Musculoskeletal Symptoms and VDU Working Conditions Among University Staff," *International Journal of Occupational Safety and Ergonomics*, 2014, 20(4), pp. 617-626.
- [16] G. Kinman, "Work stressors, health and sense of coherence in UK academic employees," *Educational Psychology*, 2008, 28(7), pp. 823-835.
- [17] J.P. Buckley et al., "The sedentary office: an expert statement on the growing case for change towards better health and productivity," *Br J Sports Med*, 2015, 49(21), pp. 1357-1362.
- [18] A. Antonovsky. The structural sources of salutogenic strengths, *Personality and stress: Individual differences in the stress process*, Chichester: Wiley, 1991.
- [19] M.C.V. Hipólito et al., "Quality of working life: assessment of intervention studies," *Rev Bras Enferm*, 2017, 70(1), pp. 178-86.

- [20] P. Cacciari, M.C.L. Haddad, J.C. Dalmas, "Worker stress level with functional rearrangement and readaptation in a public state university," *Texto & Contexto Enfermagem*, 2016, 25(2):e4640014, pp. 1-7.
- [21] F. Sadeghian, M. Raei, M. Amiri, "Persistent of Neck/Shoulder Pain among Computer Office Workers with Specific Attention to Pain Expectation, Somatization Tendency, and Beliefs," *Int J Prev Med*, 2014, 5(9), pp. 1169-1177.
- [22] M.R.M. Mainenti1 et al., "Pain, Work-related Characteristics, and Psychosocial Factors among Computer Workers at a University Center," *J. Phys. Ther. Sci.*, 2014, 26(1), pp. 567–573.
- [23] K. Tounaka et al., "Dry eye disease is associated with deterioration of mental health in male Japanese university staff," *The Tohoku journal of experimental medicine*, 2014, 233(3), pp. 215-220.
- [24] J.A. Edwards et al., "The Work-related Quality of Life Scale for Higher Education Employees," *Quality in Higher Education*, 2009, 15:3, pp. 207-219.
- [25] S. Headley et al., "Subjective and objective assessment of sedentary behavior among college employees," *BMC Public Health*, 2018, 18(1):768, pp.1-7.
- [26] E. Biernat, "Factors increasing the risk of inactivity among administrative, technical, and manual workers in warszawa public institutions," *International Journal of Occupational Medicine and Environmental Health*, 2015, 28(2), pp. 283-294.
- [27] C.A. Häfele et al., "Relationship between physical activity levels and sleep duration among technical-administrative employees from a university in South Brazil," *Rev Bras Med Trab*, 2018,16(3), pp. 305-311.
- [28] M.R. Godinho et al, "Work ability and associated factors of Brazilian technical-administrative workers in education," *BMC Res Notes*, 2016, 9:1, pp. 1-10.
- [29] M.L. Robazzi et al, "Wellbeing in the working environment in Brazilian nursing schools," *Rev. cienc. Cuidad*, 2019, 16(2), pp. 8-20.
- [30] J.M. Blanch, "Calidad de vida laboral en hospitales y universidades mercantilizados," *Papeles de Psicólogo*, 2014, 35(1), pp. 40-47.
- [31] P. Cacciari et al, "Quality of life of workers who underwent work adjustments and adaptations in a public state university," *Revista Gaúcha de Enfermagem*, 2017, 38(1):e60268, pp. 1-7.
- [32] N.A. Gillespie et al, "Occupational stress in universities: Staff perceptions of the causes, consequences and moderators of stress," *Work & Stress*, 2001, 15:1, pp. 53-72.

Fatigue levels among Family Health Strategy professionals in the Brazilian countryside

Fernanda Bernardeli Pereira

Faculdade de Medicina, Universidade Federal de Uberlândia
Uberlândia, Minas Gerais, Brasil.

Núbia Fernandes Teixeira

Instituto de Geografia, Universidade Federal de Uberlândia,
Uberlândia, Minas Gerais, Brasil.

Vanessa Cristina Bertussi

Programa de Pós-Graduação stricto sensu em Atenção à Saúde, Universidade Federal de Uberaba
Uberaba, Minas Gerais, Brasil

Samantha Pimenta Godoi

Instituto de Geografia, Universidade Federal de Uberlândia
Uberlândia, Minas Gerais, Brasil.

Kariciele Cristina Corrêa

Hospital de Clínicas, Universidade Federal do Triângulo Mineiro
Uberaba, Minas Gerais, Brasil.

Marcelle Aparecida de Barros Junqueira (Corresponding author)

Faculdade de Medicina, Universidade Federal de Uberlândia
Uberlândia, Minas Gerais, Brasil.
Email: marcellebarros@ufu.br

Abstract

Introduction: This research addresses fatigue within the team of nursing professionals of the Family Health Strategy (FHS). Objectives: To describe the fatigue levels of FHS nursing professionals. Identify the presence of fatigue among nursing professionals. Method: The research has a descriptive-analytical, quantitative character. Questionnaires were applied to a sample of 112 professionals at basic family health units in the city of Uberlândia, Brasil. Simple and applied statistics were used in order to collect the data. Results: The study showed that the sample had a greater predominance of females, aged between 30 and 49 years, with a greater number of nurses and who have only one job. It was identified with the DUF5 questionnaire that 20, 8% say that they always need extra energy to handle their daily tasks and that 36.9% of professionals have had the need to rest more. Thus, this research shows the presence of fatigue in 70.8%

of professionals. Conclusion: Evaluating the projections of fatigue on the body, this research shows self-reported signs that are already present signs, which can be recognized as symptoms and that translate signs of compromise, at some level, of the well-being of the workers in question, certainly reflecting on daily life, which may also compromise the health of these workers and their performance.

Keywords: Fatigue; Nursing; Ocupacional Health.

1. Introduction

The Family Health Strategy (FHS) comprises a collective, multi-professional approach, systematized and guided by family health teams that involves doctors, nurses, nursing technicians, dentists, assistants and / or technicians in Oral Health and Community Health Agents (CHA) that are centered on the family and the community considering the human being at the individual and collective level as a subject and social actor (Backes, Backes, Erdmann & Büscher, 2012).

FHS is essential in the community, since its primary activities are developed to protect health, promote well-being and treat pathologies resulting from the population, in addition to being able to identify the difficulties and risks that affect the residents of a given region, because in this strategy, the family becomes the focus of attention (Almeida, 2014). Studies show that in the health team it has been possible to identify and understand situations of stress and dissatisfaction with work by nursing workers, which points to little attention to their own health conditions (Camelo & Angerami, 2008).

The FHS health teams must be able to identify and attend to some aspects relating to the health of the population, among which the following stand out: the epidemiological and sociodemographic reality of families, recognizing the prevalent health problems and the risks that the population is exposed to, planning facing the triggering factors of the health-disease process, using the referral and counter-referral system, meeting spontaneous and programmed demands, promoting health education and improving individuals' self-care and encouraging intersectoral actions to face problems (Costa & Carbone, 2009).

In this context, the nursing team develops actions aimed at care, both for the scope of individual care or collective care, with teamwork, structures, technologies, goals, environment and user satisfaction being articulated. This service production aims to meet the health needs of the population with the integration of the different levels of the Unified Health System, showing the improvement in the quality of care provided in primary care (Kawata, 2011).

Caring is the work tool of these professionals, but this care can represent the cause of damage to their own health, as the work requires from these workers a routine loaded with great tension, capacity for reflection, critical analysis and constant improvement and updating of information. their technical-scientific knowledge. In addition, these professionals have long working hours, which can cause these workers, exhaustion, fatigue and affect their quality of sleep (Gontijo, 2012).

Nursing is considered a risky profession due to the exposure that the professional encounters daily, compromising his health and triggering a large number of accidents at work, occupational diseases, mental illnesses and fatigue (Silva & Pinto, 2012). Studies have found significant results for fatigue in workers from different branches of professional activities, including in the scope of health and nursing (Almeida,

2014).

In the hospital environment, the object of work of health professionals is patients and their families during the hospitalization process, with short and long-term procedures. In primary care, the object of work extends to the entire community assisted by the health team, being characterized by caring for people in a situation of illness and also within the scope of health promotion (Biff, 2016).

Nursing represents an important portion of health workers, becoming a key player in the actions performed by them. Due to this fact, the different situations experienced by nursing professionals when taking care of clients lead them to exposure to risks of physical and psychological disorder, which can be exhaustion and fatigue (Gontijo, 2012). In this research, the core of evaluating the exposure to risks of psychic disorders was: fatigue, which will be explained below.

Fatigue is defined by Aurélio as extreme tiredness or exhaustion, physical and / or mental, caused by repetitive effort or intense work (Ferreira, 2010). However, according to Queiroz (2003), fatigue is experienced by many people, however, its origin is complex and generated by the influence of several factors. This consideration given by Queiroz (2003) allows us to understand that fatigue may not be caused only by repetitive effort or intense work.

The aforementioned consideration is also added, the concept given by Mota, Cruz and Pimenta (2005). They state fatigue as an acute or chronic experience, a subjective symptom denoted by the ineffective performance of tasks, self-perceived inadequacy, aversion to activities, tiredness, feeling of weakness and discomfort. A symptom that incorporates every sensation in the body, ranging from tiredness to exhaustion, providing the professional with a condition of lack of relief that interferes with their abilities (Mota, Cruz & Pimenta, 2005). França and Rodrigues (1997) clarify the consequence of fatigue, which at its peak contributes to absenteeism at work and various psychological disorders, which, therefore, can affect the personal, family and social life of nursing professionals.

Despite the associations between fatigue and exhaustion, Silva (2011), Kroemer and Grandjean (2005) elucidate that fatigue is considered a state of physical and or mental exhaustion that can cause malaise and lack of energy that may not be exclusively related to exhaustion. Fatigue has the consequence of decreasing the capacity to perform work, resulting in loss of efficiency and a lack of interest in any activity, but it is not a single and defined state. Therefore, fatigue at work can cause changes in the mechanism of psychophysiological control when it is no longer able to meet the demands of work or meet them at the expense of increased effort and physical and mental resistance (Silva, 2011; Kroemer & Grandjean, 2005). Oliveira and collaborators (2010) explain that the appearance of fatigue can manifest itself in workers of different types of activity, from workers to health professionals. Work-related fatigue, however, can be associated with working conditions, which show how the symptoms are generated: overwork, pressure for production, the existence of an intense rhythm, lack of autonomy, lack of recognition in relation to work. performance, long journey, little time for rest and vacations, physical risks, complexity of the activity, posture during execution and among others. These conditions favor the appearance of fatigue, and the forms of its manifestation can be given at different levels, depending on the individual's relationship with the harmful activity (Oliveira, Viganó, Lunardelli, Canêo & Goular Júnior, 2010).

Finally, the concept of fatigue can be referred by nursing workers as excessive stress causing physical or mental, psycho-emotional suffering, compromising their quality of life and their work routine (Almeida,

2014). Silva (2011) explains that the work performed by nursing professionals is considered to be highly complex and exposed to high risks. This is because, according to the author, these workers handle dangerous and biological infectious chemical materials, performing, however, health risk procedures. It is also reinforced that there are risks to mental health due to the high level of tension to which they are exposed in the work environment (Silva, 2011).

With a return to the concept given by Mota and Pimenta (2002), they highlight that fatigue can only be identified by self-report by each worker, which explains why it is considered a subjective phenomenon. Therefore, the attributes can be identified through mention by the fatigued subject or by behaviors that he may present during his work routine (Mota & Pimenta, 2002).

Within the scope of nursing studies, specifically, fatigue presents itself as a negative emotion, feeling of decreased strength and endurance, exhaustion, mental or physical tiredness, indifference to less physical or mental work capacity (Conselho Internacional de Enfermeiros, 2011). While the North American Nursing Diagnosis Association (Nanda) presents a definition not different from that given by Mota, Cruz and Pimenta (2002): “an oppressive feeling, sustained by exhaustion and reduced capacity to perform physical work and mental at the usual level ”(Nanda, 2013, p. 287).

The professional activities that guarantee survival and determine the social situation of the individual, depending on the conditions in which the work is performed, can become painful and painful for the worker, which before could be something of motivation and satisfaction, becomes sacrificing, making the relationship difficult and a drop in income may occur (Almeida, 2014). After all, as Fiamoncini and Fiamoncini (2003) approach, the consequences of fatigue can be: loss of productivity in physical and mental activities, headache, depressed state and a general state of exhaustion.

The nursing team in the family health strategy (FHS) is composed of one or two generalist nurses or specialists in Family Health and one or two nursing assistants or technicians. Nursing work, especially with regard to organizational aspects, exposes workers to a series of physical and mental stressors, which can interfere with work capacity and cause fatigue in these workers, which lead to a general feeling of tiredness . The direct consequence of fatigue is the loss of efficiency, that is, the decrease in the work capacity of the nursing team (Mauro & Veiga, 2008).

The nursing team, however, whose essence is permanent health care, is daily exposed to the risk of developing fatigue. This is because these professionals face work overload focused on direct contact with patients and family members, overload of responsibilities, double shifts and crisis coping and management. For nursing professionals, fatigue is harmful both in personal and professional life, as it can negatively affect not only their health, but also the quality of care provided, thus interfering with the priority of the service, which is the technical and humanized in customer service (Lorenz, Benatti & Sabino, 2010).

Health professionals who work in the FHS, as they are working in primary care, are considered responsible for ensuring access to the health system, providing comprehensive care to the registered population. Thus, these workers are exposed to several occupational stressors since they work not only within the services, but also outside the work environment, conducting home visits, health promotion and prevention groups, visits related to epidemiological surveillance and among others. Due to their function being directly at the “entrance door”, it is perceived that they can deal directly with the demand and complaints of each client and their family and with the limitations of the health system, such as: lack of doctors, lack of vacancies in

reference services for exams and medical consultation, inadequate infrastructure, etc.

Studies indicate that when health professionals are fatigued, with exhaustion they are more prone to accidents, negligence and errors at work. Reflecting directly on the decrease in the quality of work, decrease in creativity, productivity and organizational commitment, in addition to being more predisposed to bad practice, compromising patient safety. It also affects the worker's family and social relationships (Silva, 2015).

In the context addressed above, the presence of fatigue levels in nursing professionals, can cause problems such as poor performance, decreased quality of services and staff evasion. In addition to creating feelings of professional incompetence, accidents and effects of fatigue on social life. And an increase in the risk of depression, as well as infections and cardiovascular diseases (Vasconcelos, 2009).

Therefore, the present research has as a problem the fatigue in a professional nursing public of the Family Health Strategy, which is questioned: what is the level of fatigue among the nursing professionals who work in the Family Health Strategy? The aim of this study was to analyze the fatigue levels of nursing professionals in the Family Health Strategy in Uberlândia.

2. Methodology

2.1 Outline

This is a descriptive, cross-sectional study, with a quantitative approach, to identify the fatigue level of nursing professionals who work in the FHS units, in Uberlândia / MG.

2.2 Population and Location

The research took place in the city of Uberlândia - MG (2018), state of Minas Gerais, Brazil. where there are 74 FHS teams that vary in number of professionals. Participants in this study were: assistants, nursing technicians and nurses from the Family Health Strategy (ESF) teams in Uberlândia - MG. At the time of application of this study, the city of Uberlândia contained 73 nurses and 93 nursing technicians and assistants, out of a total of 166 professionals who worked in ESF's.

However, 112 subjects participated in the research with consent, which made up the population of this study (N). Considering the ethical and legal aspects related to research involving human beings (Resolution 466/12), the present study received authorization from the service for its realization, was submitted to the evaluation of the UFU Ethics and Research Committee according to CAAE nº 47651315.4.0000.5152 and opinion final substantiated No. 1,315,972 obtained on 11/10/2015.

All study participants were invited and duly informed about the research, their rights, possible risks and the care guaranteed to them. After agreeing to participate, they signed the Free and Informed Consent Term in two copies signed by the researcher and participant, one copy of the researcher and the other copy of the participant, as regulated by the provisions of Resolution 466/12 of the National Council of Health.

2.3 Data collect

Data collection was carried out from June to August 2016. In this stage, meetings were held with nursing professionals so that everyone could be informed. This meeting was between the Management of these

places that would first explain the purpose of the research and, later scheduling to be going to these places for its application and scheduling with a minimum of seven and a maximum of 15 days for the collection of the questionnaires.

After collection, the second stage of the study was continued. The data was posted to the bank and the statistical treatment was performed. This stage started in August and ended in September 2016.

The instrument for data collection consisted of a structured, self-administered questionnaire, divided into two parts: first part referring to socio-demographic and professional information; second part regarding fatigue assessment.

Regarding socio-demographic and professional information, the following variables were collected: marital status, religion, race, occupational and educational situation. These variables facilitated the characterization of professionals.

Regarding fatigue, the Dutch Fatigue Scale - DUFS and Dutch Exertion Fatigue Scale - DEFS scales were used to evaluate it. These scales were developed by three Dutch people (Tiesinga, Dassen and Halfens) and published in 1998. DUFS measures fatigue defined as an oppressive and sustained feeling of exhaustion and reduced ability to perform physical and mental work at the usual level. DEFS measures effort fatigue defined as 'fatigue that is directly related to activity.

The DUFS was composed of 8 items, with 5 points (1-5), to be answered by self-report. The fatigue symptoms were described in the form of 8 questions, which, through their own report, the participants would indicate the level that they presented / felt each symptom. Thus, they should mark with an X in one of the five smaller squares between "no" and "yes". The "no" meant that the situation did not occur, and the "yes" stated that it occurred very often. The questions contained the term lately which referred to the last 3 to 6 months.

The symptoms were questioned by the following questions:

1. Have you been experiencing a strong and constant feeling of lack of energy lately?
2. Have you noticed lately that you need more energy to handle your daily tasks?
3. Are you feeling unwilling to do things lately?
4. Have you been waking up lately with the feeling of being exhausted and worn out?
5. Have you been needing to rest more lately?
6. Lately have you been able to do your day-to-day activities?
7. Has your interest in sex lately decreased, your desire to have sex?
8. Has it been more difficult to focus on one thing for a long time?

2.4 Data analysis

For the analysis of the data, the program Statistical Program of Social Science - SPSS - version 18 for Windows was used in which the data used came from the database elaborated in the second stage of the collection. The descriptive analysis of the data was presented in numbers, percentages, minimum and maximum values, means and standard deviation.

Fini (2008) in a study on the scale's internal validity, sensitivity and specificity of the scale defined that in individuals with 2.0 points or more, they would be considered fatigued. The criterion validity of the scales was tested with 112 patients observing correlations of 0.85 between the DUFS. Scales with 8 items with

dichotomous responses, which therefore provide total scores from 0 to 8, were also tested for sensitivity and specificity. These tests made it possible to define a cutoff point for DUFS and serve to discriminate between fatigued (DUFS <2.0) and non-fatigued (DUFS \geq 2.0).

3. Results

The socio-demographic characteristics show that the number of professionals is predominantly female (93.8%). Other characteristics noted were that 66.7% of the sample declared marital status as married. It appears that 55.7% completed higher education. It became evident that most nursing professionals have a Christian religion (Catholic 46.3%, Evangelical 35.2%, Spiritist 14.8%). In “unspecified”, it is observed in a minority (3.7%). This last percentage groups those who indicated the alternative “others” of the question about religion.

In the age group distribution of the studied population, the age most frequently, as shown in Table 1, occurred between 30 and 49 years, with no difference between men and women. The analyzed professionals, 47 (42.3%) are in the age group of 30 to 49 years.

As for the “position they hold”, there is a greater number of nurses (48.6%) than the number of nursing technicians (40.4%). It can be seen that 11% of the sample are nursing assistants; 85.3% of the sample have only one job and 14.7% have two jobs. It is also noted that 36% have about 5 to 10 years of work.

Table 1. Fatigue symptoms by nursing professionals at ESF's, Uberlândia, 2016, (n=112).

Fatigue Symptoms	Never	Rarely	Sometimes	Often	Always
	N %	N %	N %	N %	N %
Have you noticed lately that you need more energy to handle your daily tasks?	33 32,7	24 23,8	13 12,9	10 9,9	21 20,8
Have you been experiencing a strong and constant feeling of lack of energy lately?	42 41,2	27 26,5	8 7,8	9 8,8	16 15,7
Lately have you been feeling unwilling to do things?	43 41,7	24 23,3	10 9,7	13 12,6	13 12,6
Have you been waking up lately with the feeling of being exhausted and worn out?	31 30,1	27 26,2	13 12,6	12 11,7	20 19,4
Have you been needing to rest more lately?	22 21,4	20 19,4	10 9,7	13 12,6	38 36,9
Lately have you been able to do day-to-day activities?	51 51,0	24,0 24,0	4 4,0	9 9,0	12 12,0

Lately your interest in sex, your desire to have sex decreases?	45 43,7	25 24,3	8 7,8	9 8,7	16 15,5
Has it been more difficult to focus on one thing for a long time?	36 35,3	28 27,5	6 5,9	14 13,7	18 17,6

Table 1 presents statistical information regarding the participants' fatigue symptoms. It is noteworthy that 20, 8% say that they always need extra energy to handle their daily tasks. Table 2 also shows that 36.9% of professionals need to rest more.

Table 2. Distribution of workers according to the presence of fatigue Uberlândia, 2016, (N = 96).

		N		%	
Normal		28		29,2	
Altered		68		70,8	
Total		96			
	N	Minimum	Maximum	Averege	Dp
Fatigue sun	96	8	40	19,86	8,120

The data in Table 2 show the presence of fatigue in 68 workers, that is, 70.8% of nursing professionals have some indication for the level of fatigue. Table 5 shows that the standard deviation for the number of workers shown in Table 4 is 8,120.

4. Discussion

The population of nurses studied was predominantly female, (93.8%) following the historical characteristics of the profession stated by Souza et al (2014) and similar to the studies by Martins (2002), Almeida et al. (2004) and Sancinetti (2009). Regarding marital status, married workers and those living with a partner correspond to the majority (66.7%). Associated with the predominance of females in the profession and marital status, women often work a double shift. This shows an overload of work as a result of the multiple hours, which can cause fatigue to the woman, considering that her insertion in the job market, did not disconnect her from the domestic chores and care for the children, accumulating several assignments and work overload (Spíndola, 2000).

The research shows that most of the participants are adults, with an average period of time in the profession being 5 to 10 years, in the FHS, with the number of Nurses (48.6%) being greater than other professionals. These associated data can be understood in Brazil. The ESF, a model of health care organization, in the scope of primary care and primary care, in line with SUS guidelines and principles, has nurses as an important member of the multidisciplinary basic team, which has represented a field growth and social

recognition. This is because it is an active component in the process of consolidating the Strategy as an integrative and humanizing health policy (Silva, Motta & Zeitoune, 2010).

Regarding employment, the majority (85.3%) reported having only one job. The reason for this majority can be explained by the different remuneration of workers in the institutions under study, given that the double and even triple working hours in nursing can generally be understood by the low remuneration of this category (Vianey & Brasileiro, 2003).

About 20.8% of respondents answered that they need more energy to cope with their daily tasks. According to Kirchhof, Lacerda, Sarquis, Magnano and Gomes (2011), fatigue can occur if the replacement of the biofunctional capacity of the worker's body is not sufficiently recovered during his time off. Therefore, Fernandes, Miranzi, Iwamoto, Tavares and Santos (2012) explain that the opportunity to participate in recreation and leisure activities may be hindered by the percentage of nursing professionals who work in the FHS with a workload of more than eight hours a day. In another study by Elias and Navarro (2006), nurses highlighted the perception of insufficient time for rest and leisure in their speech. However, the need for survival forces them to submit to conditions of life and work that lead to fatigue at work.

So that these professionals, in this way, develop a quality work, stimulating the community in search of better health conditions, it is understood that the health professional needs quality of life, that is, he needs leisure, rest, practice of sports, and others. Because these factors that interfere with it can compromise the quality of care provided (Fernandes et al., 2012).

In research by Miranda, Silva Neto, Mello, & Antunes (2013) made with young people showing signs of anxiety, showed that the higher the intensity of physical exercise, the more it is anxiolytic for young people, with the ability to reduce the end of fatigue. This result may not be different with nurses, which is possible for young nurses to benefit from knowledge of this nature to feel stimulated and improve their quality of life.

A percentage of 36.9% of respondents reported that they have a need to rest more lately. Souza (2007) explains that when the nursing professional does not have a good rest, one of the problems that evolve is exhaustion or fatigue, in addition to drowsiness during work. Overwork may favor the appearance of a set of symptoms that affect workers physically and mentally, including ease of being distracted, drowsiness, decreased ability to concentrate, and may progress to memory lapses and confusion (Iida, 2005).

Research carried out by Lancman and Sznclwar (2011), provoke the idea that quality and lifestyle are directly related to sleep quality. Stress at work and poor sleep quality often lead workers to develop fatigue. Thus, sleep is characterized by a decrease in consciousness, reduced skeletal muscle movements and sluggish metabolism, being an essential restorative function for the nursing team.

The daily work of nursing in the FHS is visibly permeated by demands for activities and responsibilities, which has led workers to face wear and tear that can be described through a set of signs and symptoms that is reflected on the physical and mental body of workers, in the process of developing work activities, creating overload. This directly influences the worker's way of producing, since it can cause emotional instability and a deregulation of the organism, causing the appearance of signs of fatigue (Hanzelmann & Passos, 2010).

Therefore, Table 3 shows that 70.8% of workers have some indication of fatigue. With regard to this data, studies indicate that when health professionals are fatigued, with exhaustion they are more prone to

accidents, negligence and errors at work. This directly reflects in the decrease in the quality of work, in the decrease in creativity, productivity and organizational commitment, in addition to being more predisposed to bad practice, compromising patient safety. It is also added that it can affect the worker's family and social relationships (Silva, 2015).

Cross-sectional study carried out with workers in an urgency and emergency hospital in Rio Branco (Acre) brought results showing that most of them have high levels of fatigue and inadequate work capacity (Vasconcelos, Fischer, Reis, & Moreno, 2011). Thus, it is thought that among the various consequences in the work environment, fatigue can cause low performance, high rates of absenteeism, high risk of being involved in work accidents or making mistakes in the activity developed, development of stress injuries, among others.

According to Makowiec-Dabrowska, Koszada-Włodarczyk, Bortkiewicz, Gadzicka & Siedlecka (2009), in a survey of 114 men and 147 women, who analyzed the perception of fatigue and energy expenditure performing the same type of task with high physical demands, it was observed the perception of fatigue and higher energy expenditure in women. In this result, it can be assumed that, although women have only one job in the present study, they have a double workday, with the second day being domestic activities. Due to this fact, in a given time the worker may suffer with greater physical wear and consequently be more fatigued than men (Almeida, 2014).

According to Silva (2011), in an investigation carried out with workers at the University Hospital of the University of São Paulo, it showed that fatigue was detected in more than half of the nursing workers among the subjects surveyed.

Thus, the signs of fatigue manifested in the body of the workers studied, self-reported, may be expressing both physical and psycho-emotional wear, which may be due to workloads and tension resulting from the nature and meanings of the FHS in the context of changes in course in the health area, particularly in the scope of primary care (Almeida, 2014).

5. Conclusion

This study, which aimed to characterize nursing workers, from the Family Health Strategies, regarding socio-demographic and professional data and to verify the association between fatigue and their ability to work allows the following conclusions to be drawn: predominance of female and married sex. Regarding professional characteristics, it was noticed that the majority of workers are nurses, with an average period of time in the profession ranging from 5 to 10 years and only an employment contract, but with factors of extension of the workday such as housework and care with the children.

The results found in this research on the referred fatigue signs, the analyzed data point to a fatigue condition, as these workers already perceive and refer to signs that allowed this study to classify signs of fatigue in 70.8% of FHS nursing professionals.

In view of the aforementioned result, the assessment of fatigue projections on the body showed self-reported signs that objectively elucidated the alert that has been insinuating itself in this research for a possible vulnerability of the studied population. They are, therefore, signs already present, which can be recognized as symptoms and which reflect signs of commitment, at some level, to the well-being of the

workers in question, certainly coming to reflect on the daily work of the group. This may affect the results of the work performed or even compromise the health of these workers and their performance.

With the consideration of the characteristics of the nursing work and the working conditions in the primary health care environment, therefore, individual and collective interventions of an environmental and organizational nature are necessary. These actions aim to restore and maintain the capacity for work, reduce fatigue and allow improvements in the health conditions and quality of life of this population.

With the results of this research, those responsible for the safety and health of nursing professionals are recommended to promote and protect the health of these workers, and programs can be developed in order to increase the likelihood of keeping them protected from harmful effects that this work produces. Nursing is considered a risky profession due to the exposure to which the professional undergoes daily, compromising their health and triggering occupational diseases and accidents at work and even high levels of fatigue, this explains why the profession deserves the appropriate actions.

6. References

- Almeida, L. M. W. S. (2014). *Fadiga no trabalho em enfermeiras/os da estratégia saúde da família*. [Tese de doutorado]. São Carlos (SP): Biblioteca Digital de Teses e Dissertações da USP, 2014. 161 f. Available at: <http://www.teses.usp.br/teses/disponiveis/83/83131/tde-20022015-161019/pt-br.php>
- Backes, D. S., Backes, M. S., Erdmann, A. L., Büscher, A. (2012). O papel profissional do enfermeiro no sistema único de saúde: da saúde comunitária à estratégia de saúde da família. *Rev. Ciênc. Saúde Coletiva*, Rio de Janeiro, 17(1), pp. 223-230, jan. 2012. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-81232012000100024&lng=en&nrm=iso.
- Biff, D. (2016). *Cargas de trabalho de enfermeiros na estratégia saúde da família*. [Tese de doutorado]. Florianópolis: Repositório Internacional da UFSC, 245 f. Available at: <https://repositorio.ufsc.br/xmlui/bitstream/handle/123456789/175902/345610.pdf?sequence=1&isAllowed=y>
- Camelo, S. H. H. & Angerami, E. L. S. (2008 setembro). Formação de recursos humanos para a Estratégia de Saúde da Família. *Rev. Ciência, Cuidado e Saúde*. Maringá (PR), 7(1), pp. 45-52. Available at: <http://periodicos.uem.br/ojs/index.php/CiencCuidSaude/article/view/4895/3208>
- Conselho Internacional de Enfermeiros. (2011). *Classificação Internacional para a Prática de Enfermagem - Cipe®*. Versão 2.0. São Paulo: Algor.
- Costa, E. M. A. & Carbone, M. H. (2009). *Saúde da Família: uma abordagem multidisciplinar*. 2. ed. Rio de Janeiro: Rubio.
- Elias, M. A. & Navarro, V. L. (2006 agosto). A relação entre o trabalho, a saúde e as condições de vida: negatividade e positividade no trabalho das profissionais de enfermagem de um hospital escola. *Rev. Latino-Am. Enfermagem*. Ribeirão Preto (SP), 14(4), pp. 517-525. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-11692006000400008&lng=en&nrm=iso

- Fernandes, J. S., Miranzi, S. de S. C., Iwamoto, H. H., Tavares, D. M. dos S., Santos, C. B. dos. (2012 abril). A relação dos aspectos profissionais na qualidade de vida dos enfermeiros das equipes saúde da família. *Rev. esc. enferm. USP*, São Paulo, 46(2), pp. 404-412. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0080-62342012000200019&lng=en&nrm=iso
- Ferreira, A. B. H. (2010). *Dicionário da Língua Portuguesa*. 5. ed. Curitiba: Positivo.
- Fiamoncini, R. E. & Fiamoncini, R. L. (2003 novembro). O stress e a fadiga muscular: fatores que afetam a qualidade de vida dos indivíduos. *Rev. Digital Efdesportes.com*, Buenos Aires, ano 9 (66). Available at: <http://www.efdeportes.com/efd66/fadiga.htm>
- Fini, A. (2008). *Características da fadiga de pacientes com insuficiência cardíaca*. São Carlos (SP): Biblioteca Digital de Teses e Dissertações da USP, 110 f. Available at: <http://www.teses.usp.br/teses/disponiveis/7/7139/tde-13062008-105232/pt-br.php>
- Gontijo, L. M. (2012). *Avaliação da qualidade de vida e contexto de trabalho da equipe de enfermagem da Estratégia Saúde da Família de Uberaba-MG*. [Dissertação de mestrado]. Uberaba-MG: Biblioteca Digital de Teses e Dissertações da UFTM, 91 f. Available at: <http://bdtd.uftm.edu.br/handle/tede/101>
- Hanzelmann, R. S. & Passos, J. P. (2010 setembro). Nursing images and representations concerning stress and influence on work activity. *Rev. esc. enferm. USP*, São Paulo, 44(3), pp. 694-701. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0080-62342010000300020&lng=en&nrm=iso
- Iida, I. (2005). *Ergonomia: projeto e produção*. 2. ed. São Paulo: Blucher.
- Kawata, L. S. (2011). *Os desempenhos da enfermeira na saúde da família - a construção da competência no processo de trabalho*. [tese de doutorado]. Ribeirão Preto (SP): Biblioteca Digital de Teses e Dissertações da USP. Available at: <http://www.teses.usp.br/teses/disponiveis/22/22133/tde-30112011-083404/pt-br.php>
- Kessler, A. I. & Krug, S. B. F. (2012 março). Do prazer ao sofrimento no trabalho da enfermagem: o discurso dos trabalhadores. *Rev. Gaúcha Enfermagem*, Porto Alegre, 33(1), pp. 49-55. Available at: <http://C:/Users/Fernanda/Desktop/20471-109346-1-PB.pdf>
- Kirchhof, A. L. C., Lacerda, M. R., Sarquis, L. M. M., Magnano, T. S. de B. & Gomes, I. M. (2011). Understanding workload in occupational health research on nursing. *Rev. Colombia Médica*, Cali (Colômbia), 42(2), (Suplementar 1), pp. 113-119. Available at: <http://www.bioline.org.br/pdf/rc11047>
- Kroemer, K. H. E. & Grandjean, E. (2004). *Manual de ergonomia: adaptando o trabalho ao homem*. 5. ed. Porto Alegre: Bookman.
- Lacaz, F. A. C., Trapé, A., Soares, C. B., Santos, A. P. L. dos. (2013 março). Estratégia Saúde da Família e Saúde do Trabalhador: um diálogo possível? *Interface (Botucatu)*. Botucatu (SP), 17(44), pp. 75-87. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1414-32832013000100007&lng=en&nrm=iso
- Lancman, S. & Sznclwar, L. I. (2011). *Chistophe Dejours: da psicopatologia à psicodinâmica do trabalho*. 3. edição. Brasília: Editora Fiocruz.

- França, A. C. L. & Rodrigues, A. L. (1997). *Stress e trabalho: guia básico com a abordagem psicossomática*. São Paulo: Atlas.
- Lorenz, V. R., Benatti, M. C. C. & Sabino, M. O. (2010 novembro). Burnout e estresse em enfermeiros de um hospital universitário de alta complexidade. *Rev. Latino-americana de Enfermagem*, São Paulo, 18(6), pp.1084-1091 Available at: http://repositorio.unicamp.br/bitstream/REPOSIP/199170/1/pmed_21340272por.pdf
- Martins, M. M. (2002). *Qualidade de vida e a capacidade para o trabalho dos profissionais de enfermagem no trabalho em turnos*. [dissertação de mestrado]. Florianópolis-SC: Repositório Institucional da UFSC. Available at: <https://repositorio.ufsc.br/handle/123456789/84374?show=full>
- Makowiec-Dabrowska, T., Koszada-Włodarczyk, W., Bortkiewicz, A., Gadzicka, E. & Siedlecka, J. (2009). Can heaviness of the work for women be the same as for men?. *Medycyna Pracy*, Warsaw, 60(6), pp. 469-482, Available at: <https://www.ncbi.nlm.nih.gov/pubmed/20187495>
- Mauro, M. Y. C. & Veiga, A. R. (2008 jan./mar.). Problemas de saúde e riscos ocupacionais: percepções dos trabalhadores de enfermagem de unidade materna infantil. *Rev. Enfermagem da UERJ*. Rio de Janeiro, 16(1), pp. 64-69. Available at: <http://www.facenf.uerj.br/v16n1/v16n1a10.pdf>
- Miranda, R., Silva Neto, E., Mello, M. de & Antunes, H. (2014 janeiro). O nível de ansiedade traço influencia a percepção de fadiga e bem-estar após diferentes intensidades de exercício físico? *Rev. Brasileira de Atividade Física & Saúde*, Pelotas (RS), 18(6), pp. 730-739. Available at: <http://rbafs.emnuvens.com.br/RBAFS/article/view/3215>
- Moreira, J. O. (2011). Imaginários sobre aposentadoria, trabalho, velhice: estudo de caso com professores universitários. *Psicologia em Estudo*, Maringá (PR), 16(4), pp. 541- 550. Available at: <http://www.redalyc.org/articulo.oa?id=287122492005>
- Mota, D. D. C. F., Cruz, D. A. L. M. & Pimenta, C. A. M. (2005 setembro). Fadiga: uma análise do conceito. *Acta paul. enferm.*, São Paulo, 18(3), pp. 285-293. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-21002005000300009&lng=en&nrm=iso
- Mota, D. D. C. F. & Pimenta, C. A. M. (2002). Fadiga em pacientes com câncer avançado: conceito, avaliação e intervenção. *Rev. Bras. de Canc.*, Rio de Janeiro, 48(4), pp. 577-583. Available at: http://www.inca.gov.br/rbc/n_48/v04/revisao3.html
- Nanda, Associação Norte Americana de Diagnósticos de Enfermagem (North American Nursing Diagnosis Association). (2008). *Diagnósticos de enfermagem da NANDA: definições e classificação 2007-2008*. Porto Alegre: Artmed.
- Oliveira, J. R. dos S., Viganó, M. G., Lunardelli, C. F., Canêo, L. C & Goular Junior, E. (2010 setembro). Fadiga no trabalho: como o psicólogo pode atuar?. *Psicol. estud.*, Maringá (PR), 15(3), p. 633-638. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-73722010000300021&lng=en&nrm=iso
- Queiroz, M. F. F. (2003). *Compreendendo o conceito de fadiga*. [tese de doutorado]. São Paulo: Universidade de São Paulo.
- Sancinetti, T. R. (2009). *Absenteísmo por doença na equipe de enfermagem: taxa, diagnóstico médico e perfil dos profissionais*. [tese de doutorado]. São Carlos (SP): Biblioteca Digital de Teses e

- Dissertações da USP. Available at: <http://www.teses.usp.br/teses/disponiveis/7/7136/tde-14052009-113822/pt-br.php>
- Silva, A. T. C. (2015). *Esgotamento profissional e depressão em profissionais da estratégia saúde da família no município de São Paulo*. [tese de doutorado]. São Carlos-SP: Biblioteca Digital de Teses e Dissertações da USP, 167 f. Available at: <http://www.teses.usp.br/teses/disponiveis/5/5137/tde-27102015-084632/pt-br.php>
- Silva, C. D. L. & Pinto, W. M. (2012 dezembro). Riscos ocupacionais no ambiente hospitalar: fatores que favorecem a sua ocorrência na equipe de enfermagem. *Rev. Saúde Coletiva em Debate*, Serra Talhada (PE), 2(1), pp. 99-105. Available at: <http://fis.edu.br/revistaenfermagem/artigos/vol02/artigo10.pdf>
- Silva, F. J. (2011). *A capacidade para o trabalho e a fadiga entre trabalhadores de enfermagem*. [dissertação de mestrado]. São Carlos (SP): Biblioteca Digital de Teses e Dissertações da USP, 86 f. Available at: <http://www.teses.usp.br/teses/disponiveis/7/7140/tde-05072011-074244/pt-br.php>
- Silva, V.G., Motta, M.C.S. & Zeitoun, R.C.G. (2010). A prática do enfermeiro na estratégia saúde da família: o caso do município de Vitória/ES. *Rev. Eletron. Enferm.*, Goiânia, 12(3), pp.441-8. Available at: <http://dx.doi.org/10.5216/ree.v12i3.5278>
- Spíndola, T. (2000 dezembro). Mulher, mãe e... Trabalhadora de enfermagem. *Rev. esc. enferm. USP*, São Paulo, 34(4), pp. 354-361. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0080-62342000000400006&lng=en&nrm=iso
- Soratto, J., Pires, D. E. P. de., Dornelles, S. & Lorenzetti, J. (2015 junho). Estratégia Saúde da Família: uma inovação tecnológica em saúde. *Texto contexto-enferm.* Florianópolis, 24(2), pp. 584-592. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0104-07072015000200584&lng=en&nrm=iso
- Souza, J. C. (2007). Sonolência diurna excessiva em trabalhadores da área de enfermagem. *J. bras. psiquiatr.*, Rio de Janeiro, 56 (3), pp. 180-183. Available at: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0047-20852007000300004&lng=en&nrm=iso
- Souza, L. L. (2014). Representações de gênero na prática de enfermagem na perspectiva de estudantes. *Rev. Ciências & Cognição*, Rio de Janeiro, 19(2), pp. 218- 232. Available at: <http://www.cienciasecognicao.org/revista/index.php/cec/article/view/908>
- Uberlândia. Prefeitura Municipal de Uberlândia. (2017). Portal da Prefeitura de Uberlândia. Secretarias e Órgãos. Saúde. *Unidades Básicas de Saúde da Família*. Uberlândia-MG: Prefeitura Municipal de Uberlândia, 2017. Available at: <http://www.uberlandia.mg.gov.br/>
- Uberlândia. Prefeitura Municipal de Uberlândia. (2018a). *Plano municipal de saúde 2018-2021* [documento governamental]. Uberlândia-MG: Secretaria Municipal de Saúde. Available at: http://www.uberlandia.mg.gov.br/uploads/cms_b_arquivos/18476.pdf
- Uberlândia. Prefeitura Municipal de Uberlândia. (2018b). Portal da Prefeitura de Uberlândia. Secretarias e Órgãos. Saúde. *Unidades Básicas de Saúde da Família*. Uberlândia (MG): Prefeitura Municipal

de Uberlândia. 2018b. Available at: http://www.uberlandia.mg.gov.br/2014/secretaria-pagina/65/2450/unidades_basicas_de_saude_da_familia.html

Vasconcelos, S. P. (2009). *Avaliação da capacidade para o trabalho e fadiga entre trabalhadores de enfermagem em um hospital de urgência e emergência na Amazônia Ocidental*. [Dissertação do mestrado]. São Carlos (SP): Biblioteca Digital de Teses e Dissertações da USP, 2009. 100 f.

Available at: <http://www.teses.usp.br/teses/disponiveis/6/6136/tde-27012011-160853/pt-br.php>

Vasconcelos, S. P., Fischer, F. M., Reis, A. O. A. & Moreno, C. R. de C. (2011 dezembro). Fatores associados à capacidade para o trabalho e percepção de fadiga em trabalhadores de enfermagem da Amazônia Ocidental. *Rev. bras. epidemiol.*, São Paulo, 14(4), pp. 688-697. Available at:

[http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-790X2011000400015&lng=en&nrm=iso)

[790X2011000400015&lng=en&nrm=iso](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S1415-790X2011000400015&lng=en&nrm=iso)

Vianey, E. L. & Brasileiro, M. E. (2003 outubro). Saúde do Trabalhador: condições de trabalho do pessoal de enfermagem em hospital psiquiátrico. *Rev. bras. enferm.*, Brasília (DF), 56(5), pp. 555-

557. Available at: [http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-71672003000500017&lng=en&nrm=iso)

[71672003000500017&lng=en&nrm=iso](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-71672003000500017&lng=en&nrm=iso)

Risk Return Optimization Using the Knapsack Problem in The Formation of a Stocks Portfolio. Case Study of a Brazilian Investment Site.

Nicolas Sampaio Bevilaqua, OCILEIDE Custodio da Silva, GABRIELA DE MATTOS
VERONEZE

Federal University of Amazonas
Brazil

Abstract

In this work, the composition of a portfolio was proposed by using the Knapsack problem and verified its effectiveness in comparison to a portfolio of shares on an investment website. The programming variables were based on the Markowitz risk theory of variance and following collaborators for their studies. And from the chosen portfolio, the efficient frontier was elaborated analyzing the performance of the investment site portfolio during 30 days. The portfolio obtained exceeded the percentage performance obtained from the investment site in the same period when considering the maximum possible return, the minimum global variance and also in the naive distribution.

Keywords: Integer programming; Knapsack Problem; Variance Risk; Efficient Frontier.

1. Introduction

Building an investment portfolio is a task that takes into account numerous aspects related not only to the assets themselves, but also to the profile of the investor who will be performing such a task. The common objective, however, is always the same, to obtain the highest return in the face of the lowest possible risk exposure.

The problem initially proposed by (Markowitz, 1958). He presented a model of risk variance where he proved that diversification, observing the correlation of assets, there was an increase in the theoretical portfolio return given the same risk. (Sharpe, 1967) developed the capital asset pricing model (CAPM) and created an index to measure the relationship between risk and investment performance. (Morita et al, 1989) present a stochastic maximization model through the backpack problem with a matrix of variance and covariance. (Konno & Yamasaki, 1990) showed improvements in relation to the Markowitz study introducing a risk calculated as Mean Standard Deviation (MAD). (Speranza, 1991) presented advances in the linear programming model, using the method of mean absolute deviation.

The literature shows numerous advances and studies in determining the portfolio, such as the use of *Fuzzy* and *AHP* methodologies. However, many articles fail to demonstrate the theoretical results compared to the results obtained in practice by the market, due to the great complexity in the parameters used in determining the simulation models.

This study presents a simplistic approach to the application of the *Knapsack Problem* in obtaining assets for the formation of a portfolio and to comparing the theoretical results with the practical ones. First, it was necessary to establish a basic income objective to be obtained. In this case, a Brazilian investment site was chosen that compiles the indications of the collaborating investment brokers. The ten most recommended stocks make up the official portfolio of the website where the performances of these papers were verified in the interval of 30 days. Using the indications of the main brokers, binary programming was applied, using the data of return, risk (standard deviation) and correlation where the objective functions were established as the restrictions to be used in the programming. In a second step, the efficient frontier was assembled using the covariance of the assets obtained to verify the optimal points of resource allocation.

This work is organized into four sections: Section 2 presents methodological research on the problem of knapsack problem, efficient frontier and portfolio selection. Section 3 presents the numerical results obtained and illustrations, while section 4 contains the conclusions obtained.

2. Theoretical foundations

2.1 Integer Programming

An Integer Programming problem is a model in which the constraints and the objective function are identical to those formulated in linear programming. However, in some cases, the decision variables only make sense, as in the case of the article in question, when they have integer values (Hillier & Liebermann, 2006). According to (Render, 2012) throughout the programming, we have three types of solution:

- a) Pure, where they receive whole values.
- b) Mixed, where some have integer values.
- c) Binary, where the decision variables must receive the values of 0 or 1. (Object of study of the article).

The knapsack problem consists of the classic binary programming problem in operational research, where it seeks to determine, among the n possible objects, which of them should be carried in the backpack, taking into account their usefulness and weight. Given a weight restriction, the goal is to maximize the overall usefulness of the backpack. Equation 01 concerns the objective function of maximizing the object's usefulness. Equation 02 refers to a weight capacity restriction that cannot be overcome. Equation 03 refers to the restriction on the values that must be mandatory 0 or 1. Expressed by the functions below:

$$Fobj = Max z = \sum_i^n P_i X_i \quad (01)$$

$$\sum_i^n p_i x_i \leq C \quad max \quad (02)$$

$$x_i \in (0,1) \quad (03)$$

Model parameters:

x_i = utility of object i

p_i = weight of object i

C_{max} = backpack capacity

Decision variables: 1 if the object is in the backpack or 0 otherwise.

Analogously for the work, it was proposed to change the parameters for proper application. The objective in the case of the work was to minimize the risk of the portfolios given a restriction in the average correlation of the assets with each other, which can be written as follows:

$$F_{obj} = \text{Min } z = \sum_i^n C_i X_i \quad (01)$$

$$\sum_i^n p_i x_i \leq C_{\text{orrel. max}} \quad (02)$$

$$x_i \in \{(0,1)\} \quad (03)$$

Model parameters:

c_i = risk (Standard deviation) of stock i

x_i = mean correlation of stock i

Correl. max = minimize portfolio risk given the restricted correlation between assets
Decision variables: 1 if the stock is in the portfolio and 0 otherwise.

2.2 Efficient frontiers

Markowitz (1958) introduced in his famous work "Portfolio Selection" terms that are widely used until today as portfolio risk, diversification and optimization (Galiene & Stravinskyte, 2016). In addition, he was the first to prove mathematically that diversification reduced the portfolio's risk (Cibulskien & Grigaliuniene, 2007).

Based on the risk and return estimates of the assets, Markowitz proposes the creation of the so-called efficient average variance frontier (Figure 1), capable of demonstrating the maximum expected return of a portfolio against a given risk.

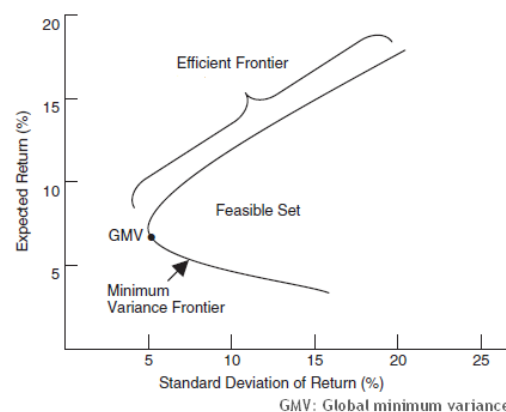


Figure 1: Exemplification of efficient Markowitz frontier

Source: Investment and Finance (2019).

The curve represents the optimal portfolios, which are: 1) The most profitable given a level of risk or 2) The lowest risk given a level of profit. However, as all options are optimal, the choice is up to each investor depending on their level of risk aversion and external factors (Galiene & Stravinskyte, 2016).

The frontier is calculated with the optimal point for each estimated theoretical return interval, in order to minimize the covariance given the following restrictions: maximum and minimum allocation in each asset (guarantee diversification) and the maximum and minimum value of each interval that is desired obtain the optimal allocation point, since without these restrictions we would have a single optimal value, and it would not be possible to set up the efficient frontier. As per the schedule below:

Decision Variables:

$$x_i = \text{covariance of each investment}$$

Decision Parameters:

$$R_i = \text{Return of portfolio}$$

$$R_s = \text{Return of simulation}$$

Objective Function:

$$\text{Min} = \sum_i^n x_n \quad \forall i \quad (01)$$

Subject to:

Maximum percentage allocated to each share:

$$\sum_i^n x_i \leq R_i \quad \forall i \quad (02)$$

Minimum percentage allocated to each share:

$$\sum_i^n x_i \leq R_s \quad (03)$$

Return of the portfolio above the minimum limit for the simulation:

$$\sum_i^n x_i \geq R_i \quad (04)$$

No Negativity:

$$x_i \in (0,1) \quad \forall i$$

Due to the complexity of the calculations that involves several variables, common in problems of optimization of variables, the formulations above were performed in Microsoft Excel®.

3. Methodology

The objective was to obtain a portfolio of 10 shares in order to have a yield higher than that obtained by the official portfolio of the website in question. The *website's* portfolio was obtained from the 10 most recommended stocks by brokers. In this way, a binary model was proposed, in which 10 shares were obtained, which must have a percentage yield higher than that of the site in question.

3.1 Shares chosen

Data were extracted from the daily quotations of 22 shares, resulting from the indications of the 5 brokerages with the best percentage performance accumulated until the month of November 2019, from September to November 2019, from the official Brazilian investment *website*. Thus, the average daily risk and return of the 90 days prior to the beginning of the 30-day simulation was obtained, as shown in Table 1.

Table 1 - Average daily risk image, average monthly return.

	LREN3F	MOVI3F	RADL3F	SULA11F	VIVT4F	EZTEC3F	JBSS3F	KLBN11F	PETR4F	VVAR3F	B3SA3F	LINX3F	PCAR4F	BPAC11F	FLRY3F	GRND3F	LAME4F	WEGE3F	BBDC4F	CPFE3F	CVCB3F	VALE3F
RET	0,0006	0,0011	0,0037	0,0017	0,0006	0,0013	-0,0001	0,0028	0,0023	0,0024	0,0013	0,0004	-0,0010	0,0030	0,0029	0,0051	0,0029	0,0047	0,0007	-0,0004	-0,0043	0,0015
DESV	0,0151	0,0173	0,0142	0,0152	0,0112	0,0243	0,0250	0,0161	0,0149	0,0231	0,0147	0,0247	0,0154	0,0209	0,0136	0,0143	0,0177	0,0154	0,0163	0,0155	0,0259	0,0168

Source: Research data (2020).

The following were considered for optimization: the average risk (standard deviation) and the correlation average of each stock, obtained by Microsoft Excel®, of the 22 pre-selected assets as shown in table 2. The risk minimization program given was applied the mean correlation constraint as shown in table 2 in the appendix.

In table 3 we can see the result of the programming carried out, the 10 actions were obtained where the value of the minimization obtained was 0.1466 with the correlation of 2.39, thus respecting the restriction of 2.40, which was obtained through *benchmarking* of the correlation of the portfolios of the main brokers (average of 0.24 per share).

Table 3 - Result of chosen shares

Share	(Stdev)	Correlation	Object	Result	Stdev_tot
LREN3F	0,0151	0,3698	0	0,0000	0,1466
MOVI3F	0,0173	0,3396	0	0,0000	
RADL3F	0,0142	0,2185	1	0,2185	
SULA11F	0,0152	0,2530	1	0,2530	
VIVT4F	0,0112	0,2864	1	0,2864	
EZTEC3F	0,0243	0,2667	0	0,0000	
JBSS3F	0,0250	0,0829	0	0,0000	

KLBN11F	0,0161	0,2220	1	0,2220
PETR4F	0,0149	0,2038	1	0,2038
VVAR3F	0,0231	0,3313	0	0,0000
B3SA3F	0,0147	0,3278	0	0,0000
LINX3F	0,0247	0,2186	0	0,0000
PCAR4F	0,0154	0,3108	0	0,0000
BPAC11F	0,0209	0,2367	0	0,0000
FLRY3F	0,0136	0,2722	1	0,2722
GRND3F	0,0143	0,3091	1	0,3091
LAME4F	0,0177	0,3575	0	0,0000
WEGE3F	0,0154	0,1661	1	0,1661
BBDC4F	0,0163	0,2053	1	0,2053
CPFE3F	0,0155	0,2543	1	0,2543
CVCB3F	0,0259	0,2521	0	0,0000
VALE3F	0,0168	0,2013	0	0,0000
			10	2,3907
				2,4
				CORREL_TOT
				RESTRICTION

Source: Research data (2020).

3.2 Assembly of the efficient frontier

From the 10 actions obtained, the covariance matrix (table 4) was obtained by Microsoft Excel®, together with the average monthly return on the actions of the collected data, and it was applied to the programming in order to obtain the minimization of the covariance as explained in item 2.2.

Table 4 - Variance / covariance table

	RADL3F	SULA11F	VIVT4F	KLBN11F	PETR4F	FLRY3F	GRND3F	WEGE3F	BBDC4F	CPFE3F
RADL3F	0,000199	0,000064	0,000042	0,000023	0,000010	0,000010	0,000046	0,000031	0,000006	0,000068
SULA11F	0,000064	0,000227	0,000054	0,000022	0,000011	0,000028	0,000043	0,000048	0,000001	0,000073
VIVT4F	0,000042	0,000054	0,000123	0,000026	0,000010	0,000041	0,000039	0,000027	0,000025	0,000047
KLBN11F	0,000023	0,000022	0,000026	0,000255	0,000077	0,000046	0,000040	0,000126	0,000049	0,000003
PETR4F	0,000010	0,000011	0,000010	0,000077	0,000218	0,000059	0,000076	0,000009	0,000073	0,000006
FLRY3F	0,000010	0,000028	0,000041	0,000046	0,000059	0,000182	0,000064	0,000037	0,000053	0,000036
GRND3F	0,000046	0,000043	0,000039	0,000040	0,000076	0,000064	0,000201	0,000041	0,000047	0,000048
WEGE3F	0,000031	0,000048	0,000027	0,000126	0,000009	0,000037	0,000041	0,000233	0,000072	0,000042
BBDC4F	0,000006	0,000001	0,000025	0,000049	0,000073	0,000053	0,000047	0,000072	0,000261	0,000022

CPFE3F	0,000068	0,000073	0,000047	0,000003	0,000006	0,000036	0,000048	0,000042	0,000022	0,000237
---------------	----------	----------	----------	----------	----------	----------	----------	----------	----------	----------

Source: Research data (2020).

For the formation of the efficient frontier, it was necessary to establish the intervals for the construction of the graph. Without the restrictions we would only obtain the point of minimum global variance, which in this case would be an estimated return of 5.12% for an estimated risk of 0.70%. The lowest value obtained respecting the restrictions was a return of 2.82% for a risk of 0.80% and the highest value obtained was 7.62% for an equal risk of 0.80%.

Table 5. Result of efficient border points after programming

St.Dev	Ret[r]	RADL3F	SULA11F	VIVT4F	KLBN11F	PETR4F	FLRY3F	GRND3F	WEGE3F	BBDC4F	CPFE3F
0,80%	7,62%	20,00%	2,50%	2,50%	7,50%	2,50%	20,00%	20,00%	20,00%	2,50%	2,50%
0,73%	6,50%	20,00%	3,80%	8,70%	2,50%	12,70%	11,40%	10,90%	20,00%	2,50%	7,50%
0,71%	6,00%	20,00%	3,50%	12,00%	2,50%	13,90%	10,30%	5,90%	20,00%	2,50%	9,30%
0,70%	5,12%	16,00%	4,50%	18,20%	2,50%	14,80%	8,00%	2,50%	17,40%	4,40%	11,80%
0,72%	4,00%	8,60%	9,10%	20,00%	3,30%	14,70%	5,70%	2,50%	9,50%	10,70%	15,90%
0,77%	3,00%	2,50%	13,30%	20,00%	5,50%	13,30%	2,50%	2,50%	2,50%	17,90%	20,00%
0,80%	2,82%	2,50%	20,00%	20,00%	2,50%	7,50%	2,50%	2,50%	2,50%	20,00%	20,00%

Source: Research data (2020).

For comparison purposes, naive distribution was considered, that is, the application of the programming used at the efficient frontier was disregarded and the percentage of share participation was the same for all. Considering this, an estimated return of 5.23% was obtained for a risk of 0.74%, represented by the triangle in figure 2.

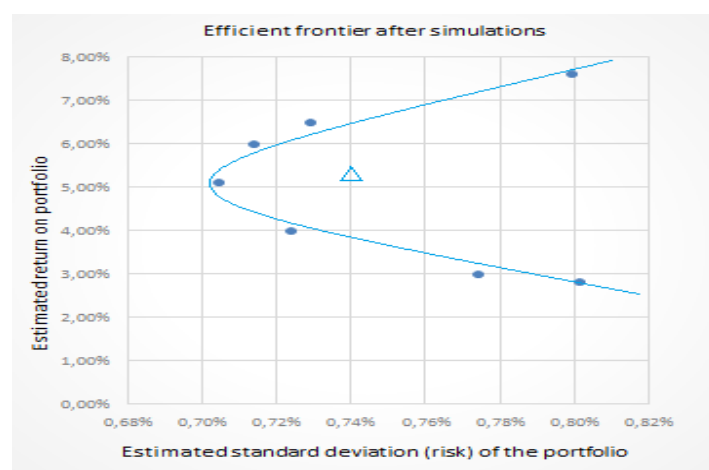


Figure 2 - Illustration of the efficient frontier obtained

Source: Authors (2020).

4. Results and discussion

The period selected for analysis was marked by a sharp rise in the stock exchange due to the momentary animation due to external factors such as the signaling of structural reforms in the country. The percentage performance of 10 shares obtained through binary programming was observed and was compared to a Brazilian investment website portfolio, which for the period analyzed obtained the result of 7.23%, where the naive distribution was used. The application of the Knapsack Problem to obtain a portfolio proved to be a good complementary tool in the analysis of the composition of investment portfolios of variable income. For this, it was necessary a solid fundamentalist and technical analysis of shares for an initial filtering to be carried out on the stocks where the simulations will be carried out. The bold investment profile (Maximum return) was the one with the highest return (8.72%) with a result 14.43% higher than estimated. The conservative profile (Minimum global variance) obtained a return of 7.33% (43.16% higher than initially estimated). And the naive distribution, which corresponds to an equal allocation between the shares (without the need to carry out the LP) obtained a result of 7.87% (50.47% higher than initially estimated). Table 2 presents the summary of estimated results versus results obtained by investment profiles.

Table 2. Summary of estimated versus obtained results from investment profiles.

Invest. profile	Stdev estimated	Return Estimated	Result obtained	Reached the goal? (7.23%)
Bold (Max. return)	0.80%	7.62%	8.72%	YES
Global minimum	0.70%	5.12%	7.33%	YES
Naive distribution	0.74%	5.23%	7.87%	YES

Source: Research data (2020).

Preliminary binary programming proved to be a useful tool in the quantitative formation of the portfolio, since all the arrangements made via PL to obtain the efficient frontier (global minimum and maximum return), as well as the naive distribution, exceeded the result obtained through the Valor.com portfolio in December 2019 (7.23%).

The naive diversification between roles proved to be more effective in the estimated versus obtained item than the allocations for the minimum global variance (conservative profile) and maximum return (bold profile). One of the causes is that a greater allocation in a single asset can increase the portfolio's weight and risk in face of non-diversifiable risks, in this way that allocation via the efficient frontier has great theoretical utility, but not necessarily practical.

5. References

[1]Cibulskienė, D. and Grigaliūnienė, Z. (2007). The Genesis and Development of Modern Portfolio Theory, Economics and Management: Current Issues and Perspectives, p. 52–61, Šiauliai University.

- [2]Galiniene, B and Stravinskytė, J.(2016). Constructing an optimal investment portfolio for the bank of Lithuania, *Ekonomika*, 2016, Vol. 95(1).
- [3]Gupta, P, Mehlawat, K and Saxena, A.(2010). “A hybrid approach to asset allocation with simultaneous consideration of suitability and optimality,” *Information Sciences*, vol. 180, no. 11, pp. 2264–2285, 2010.
- [4]Investment and Finance. Portfolio Management. (2020). Available at: <https://www.investment-and-finance.net/portfolio-management/e/efficient-frontier.html>. Acessado em 30 de julho.
- [5]Konno, H and Yamazaki, H. (1991). “Mean-absolute deviation portfolio. Optimization model and its applications to Tokyo stockmarket,”. *Management Science*, vol. 37, no. 5, pp. 519–531.
- [6]Malaj, E and Malaj, V. (2016). Portfolio Allocation: An Empirical Analysis of Ten American Stocks for the Period 2010-2015. *International Journal of Accounting, Finance and Risk Management*. Vol. 1, No. 1, 2016, pp. 11-18.
- [7]Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, vol.7, no. 1, pp. 77–91, 1952.
- [8]Morita, H. (1989). Stochastic linear knapsack programming problem and its application to a portfolio selection problem. *European Journal of operational Research*, vol. 3, no. 4, pp. 329-336, 1989.
- [9]Sekar, G. (2012). “Portfolio optimization using neuro fuzzy system in Indian stock market,” *Journal of Global Research in Computer Science*, vol. 3, no. 4, pp. 44–47, 2012.
- [10]Sharpe, W. (1971). A linear programming approximation for the general portfolio.(1971a). analysis problem. *Journal of Financial and Quantitative Analysis* 6, 1263–1275.
- [11]Sharpe, W.(1971). Mean-absolute deviation characteristic lines for securities and portfolios. *Management Science* 18, B1–B13
- [12]Speranza, M. (1993). “Linear programming models for portfolio optimization,” *Finance*, vol. 14, pp. 107–123, 1993..+

Table 2 - Stock correlation table and average correlation

VALE	0.207	0.291	0.180	0.154	0.104	-0.020	0.088	0.226	0.273	0.170	0.011	0.037	0.240	-0.017	0.376	0.227	0.057	-0.057	0.377	0.233	0.271	1.000	0.201	
CVCB	0.332	0.325	0.083	0.068	0.001	0.204	-0.155	0.187	0.318	0.300	0.233	0.239	0.322	0.195	0.326	0.312	0.440	-0.026	0.247	0.325	1.000	0.271	0.252	
CPFE	0.476	0.333	0.313	0.313	0.278	0.392	-0.036	-0.012	0.027	0.448	0.254	0.162	0.361	0.206	0.173	0.221	0.218	-0.180	0.089	1.000	0.325	0.233	0.254	
BBDG	0.180	0.145	0.027	-0.006	0.138	-0.029	0.013	0.192	0.306	0.127	0.343	0.166	0.086	0.115	0.243	0.204	0.263	0.291	1.000	0.089	0.247	0.377	0.205	
WEG	-0.021	0.098	-0.143	0.211	0.162	-0.051	0.103	0.517	0.042	0.111	0.422	0.192	0.013	0.396	0.181	0.191	0.203	1.000	0.291	-0.180	-0.026	-0.057	0.166	
LAM	0.560	0.408	0.364	0.378	0.496	0.278	0.051	0.157	0.144	0.556	0.473	0.410	0.482	0.286	0.313	0.332	1.000	0.203	0.263	0.218	0.440	0.057	0.358	
GRN	0.441	0.462	0.231	0.203	0.246	0.246	0.088	0.179	0.365	0.225	0.223	0.214	0.543	0.313	0.334	1.000	0.332	0.191	0.204	0.221	0.312	0.227	0.309	
FLRY	0.339	0.382	0.051	0.137	0.274	0.233	0.099	0.212	0.295	0.342	0.248	0.005	0.154	0.272	1.000	0.334	0.313	0.181	0.243	0.173	0.326	0.376	0.272	
BPAC	0.234	0.217	-0.005	0.363	0.175	0.281	-0.034	0.209	0.045	0.235	0.334	0.153	0.236	1.000	0.272	0.313	0.286	0.396	0.115	0.206	0.195	-0.017	0.237	
PCAR	0.466	0.411	0.291	0.311	0.304	0.360	0.141	0.104	0.166	0.324	0.293	0.230	1.000	0.236	0.154	0.543	0.482	0.013	0.086	0.361	0.322	0.240	0.311	
LINX	0.214	0.118	0.125	0.116	0.166	0.192	0.015	0.194	0.206	0.209	0.445	1.000	0.230	0.153	0.005	0.214	0.410	0.192	0.166	0.162	0.239	0.037	0.219	
BBSA	0.366	0.341	0.268	0.299	0.388	0.346	-0.010	0.352	0.238	0.343	1.000	0.445	0.293	0.334	0.248	0.223	0.473	0.422	0.343	0.254	0.233	0.011	0.328	
VVAR	0.640	0.338	0.280	0.374	0.505	0.487	0.112	0.146	0.018	1.000	0.343	0.209	0.324	0.235	0.342	0.225	0.556	0.111	0.127	0.448	0.300	0.170	0.331	
PETR	0.270	0.347	0.050	-0.049	0.059	0.001	0.035	0.325	1.000	0.018	0.238	0.206	0.166	0.045	0.295	0.365	0.144	0.042	0.306	0.027	0.318	0.273	0.204	
KLBN	0.135	0.217	0.100	0.092	0.145	0.136	0.069	1.000	0.325	0.146	0.352	0.194	0.104	0.209	0.212	0.179	0.157	0.517	0.192	-0.012	0.187	0.226	0.222	
JBSS3	-0.053	0.009	0.017	0.126	0.150	-0.003	1.000	0.069	0.035	0.112	-0.010	0.015	0.141	-0.034	0.099	0.088	0.051	0.103	0.013	-0.036	-0.155	0.088	0.083	
EZTE	0.513	0.531	0.294	0.218	0.261	1.000	-0.003	0.136	0.001	0.487	0.346	0.192	0.360	0.281	0.233	0.246	0.278	-0.051	-0.029	0.392	0.204	-0.020	0.267	
VIVT	0.469	0.390	0.270	0.320	1.000	0.261	0.150	0.145	0.059	0.505	0.388	0.166	0.304	0.175	0.274	0.246	0.496	0.162	0.138	0.278	0.001	0.104	0.286	
SULA	0.389	0.246	0.300	1.000	0.320	0.218	0.126	0.092	-0.049	0.374	0.299	0.116	0.311	0.363	0.137	0.203	0.378	0.211	-0.006	0.313	0.068	0.154	0.253	
RADL	0.411	0.297	1.000	0.300	0.270	0.294	0.017	0.100	0.050	0.280	0.268	0.125	0.291	-0.005	0.051	0.231	0.364	-0.143	0.027	0.313	0.083	0.180	0.219	
MOVI	0.565	1.000	0.297	0.246	0.390	0.531	0.009	0.217	0.347	0.338	0.341	0.118	0.411	0.217	0.382	0.462	0.408	0.098	0.145	0.333	0.325	0.291	0.340	
LREN3	1.000	0.565	0.411	0.389	0.469	0.513	-0.053	0.135	0.270	0.640	0.366	0.214	0.466	0.234	0.339	0.441	0.560	-0.021	0.180	0.476	0.332	0.207	0.370	
-	LREN	MOVI	RADL	SULA	VIVT4	EZTE	JBSS3	KLBN	PETR4	VVAR	BBSA3	LINX3	PCAR	BPAC	FLRY3	GRND	LAME	WEGE	BBDG	CPFE3	CVCB	VALE3	CORRE	LATION

Source: Research data (2020).

The use of conflict mediation by the Sergipe River Basin Committee as a tool for implementing decentralised water resource management

Vanessa Gomes de Araújo

Programa de Pós-graduação em Desenvolvimento e Meio Ambiente,
Universidade Federal de Sergipe,
São Cristóvão, Sergipe, Brasil.

Gregorio Guirado Faccioli

Departamento de Engenharia Agrícola,
Universidade Federal de Sergipe,
São Cristóvão, Sergipe, Brasil.

Raimundo Rodrigues Gomes Filho

Departamento de Engenharia Agrícola,
Universidade Federal de Sergipe,
São Cristóvão, Sergipe, Brasil.

Anderson de Almeida Santos

Programa de Pós-graduação em Recursos Hídricos,
Universidade Federal de Sergipe,
São Cristóvão, Sergipe, Brasil.

Juan Mariano Camarillo Naranjo

Departamento de Geografía Física y Analisis Geográfico Regional,
Universidad de Sevilla, Sevilla, España

Clayton Moura de Carvalho

Instituto Federal de Educação, Ciência e Tecnologia Baiano,
Serrinha, Bahia, Brasil.

Rodrigo Couto Santos

Faculdade de Ciências Agrárias,
Universidade Federal da Grande Dourados
Dourados, Mato Grosso do Sul, Brasil.

Abstract

Parallel to the growing demand for multiple uses of water, conflicts between its users appear, contributing to the increase in the number of cases submitted to the Judiciary. This study aimed at

analyzing the existence of mediation as a method of resolving possible conflicts related to water resources in the Sergipe River Basin. The qualitative approach research was developed based on a bibliographic survey, by means of consultations with books, pertinent legislation, articles in scientific and non-scientific journals and, documental, through the analysis of the minutes of the meetings of the Sergipe River Basin Committee, its Internal Regulations and the Climatological Report that analyses the rainfall variability by regions in Sergipe, from 2000 to 2017. The results revealed that despite moving towards recognizing mediation as a method for resolving conflicts, the Committee faced several difficulties in carrying out decentralized management of water resources, especially with regard to the resolution of water disputes. Possible solutions to some of the problems faced by the Committee can be pointed out, such as training its members in water resource management and conflict management, in addition to making them aware of participating frequently in Committee meetings and also stimulating the participation of the population in these meetings.

Keywords: sustainability; water management; extrajudicial methods.

1. Introduction

Currently, the water crisis is becoming more and more present in the world scenario. The complexity of the hydroelectric crisis has been aggravated as there are real difficulties of availability and increase of demand respectively (Leroux, Martin and Zheng 2018).

In parallel with population growth and the consequent increase in economic activities, several countries are moving rapidly towards conditions of water unavailability or are already facing some hindrance, caused by water scarcity, so that they can develop economically, this due to the anthropogenic pressure to which water resources are being subjected.

The increase in water demand as a result of the various methods of using water resources, such as human supply, irrigation, aquaculture, agriculture, recreation, tourism and industrial supply, lead to the emergence of conflicts between users, thus raising the level of complexity of management problems, making it necessary to emerge or improve new techniques for solving these conflicts.

Brazil is not free to face problems of crisis and water scarcity facing a scenario of high demand, despite occupying a privileged position in relation to other countries in relation to its water availability (Borba and Bayer 2015).

More specifically in the Northeast region of the country, in addition to its edafoclimatic characteristics, the water crisis results mainly from the highly predatory intervention in the use of this finite natural good. In Sergipe, the situation does not differ, because despite having its eight hydrographic basins, the Sergipe state already presents regions where the unavailability of water, with commitment in quantity and quality, especially in the most urbanized hydrographic basins, is present, a crucial factor for the emergence of water disputes by its users.

The way found to manage this competition and provide greater equity in access to water was the creation of rules and instruments for managing water resources that institutionalize them, as well as the creation of the local decision-making body, in this case the River Basin Committees. In this regard, Law 9.433/97,

which is responsible for establishing the National Water Resources Policy, has as one of its bases that water is a public good, endowed with economic value, whose priority uses are human and animal consumption and whose management must take the watershed as a territorial unit. Law 9.433/97 allowed the river basins, in the form of management units, to be established on a case-by-case basis, giving them the possibility to conform to the specificities of the local problem. Even so, many of the conflicts generated by the multiple uses of water end up being directed to the judicial spheres.

Law 3.870, of September 25, 1997, which provides for the State Water Resources Policy and the State Water Resources Management System, in its article 35, item III, provides that the State Water Resources Council, an organ of coordination, inspection and collective deliberation and normative of the State Water Resources Management System, has, among others, the power to arbitrate, in the last administrative instance, the existing conflicts between watershed and water users.

Also, with regard to the arbitration of conflicts related to water resources, item II of article 39 of Law 3.870, of September 25, 1997, states that it is the responsibility of the Hydrographic Basin Committees, consultative and deliberative bodies, at the level of hydrographic basins, to arbitrate, in the first administrative instance, conflicts related to water resources.

The Hydrographic Basin Committee, composed of several representative segments of various categories of society, such as representatives of public authorities, users and civil society entities linked to water resources, has full legitimacy to act, in a collegial manner, in the management of the waters present within its area of competence. With this multisectoral coverage, favourable conditions are created for the watershed Committee to influence public policies in the sector and negotiate water use conflicts in a democratic manner (Sergipe 2002).

Following the same heterogeneous pattern in its formation, the Sergipe River Basin Committee was instituted by State Decree No. 20.778, of June 21, 2002 and, according to Article 4 of its Internal Regulations, the Committee is composed of eight representatives from the public authorities, eight representatives from the Water Users segment and eight representatives from the Civil Society segment (Sergipe 2002).

The State Water Resources Policy, established by Law no. 3,870 of September 25, 1997, provides for integrated, decentralized and participatory management, with the River Basin Committees and Water Resource Councils as bodies of relevant importance with regard to water management.

Although Brazil has a large *acquis* of material and procedural legislation on water resource management and the judicial means of resolving its controversies, the Judiciary faces difficulties in effectively resolving water disputes.

The Judiciary has been demanded as a result of the most varied types of conflicts and most of the time without the parties having previously tried to resolve the conflict without state interference, which generates a deficient and obstructed performance. These obstacles can arise from the large number of cases that make the decision-making process time-consuming, as well as from the large number of jurisdictional procedures or even the high economic cost of the proceedings. Thus, the affirmed crisis of the Judiciary precludes the rapid resolution of conflicts (Yarshell 2004).

The slowness of the Judiciary in responding to the judicial demand is also a reason for the use of alternative methods of conflict resolution, since time is a great enemy of the effectiveness of the

peacemaker function, considering that the permanence of undefined conflicting situations is a factor of personal anguish and unhappiness (Cintra et al. 2009).

In this context, it is important to use alternative means of conflict resolution so that the parties involved in the dispute can participate in the decision-making process and, in the end, are satisfied, and with the conflict, in fact, resolved. In this way, the use of conflict mediation strengthens practices that value a new way of managing the use of water resources, thus hindering the unrestrained increase of controversies in multiple water uses.

What should be sought is the guarantee of effective access to justice, where it is possible to guarantee the right claimed, a material right, substantial, effectively realized and not only the guarantee of a formal right, that established in legislation (Câmara 2006).

Thus, the objective of the present work was to analyze the existence of mediation as a method of resolving possible conflicts related to water resources in the Sergipe River Basin, since it is a method that can speed up the resolution of these conflicts, since the problem is solved in the first administrative instance, under the jurisdiction of the Hydrographic Basin Committees and there will be no need to resort to legal actions, generally time-consuming, to resolve these types of processes and, with this, greater protection of water resources can be achieved. Furthermore, it aimed at identifying possible conflicts related to water resources in the Sergipe River Basin in the years 2003, 2004, 2012, 2013, 2014, 2015, 2016 and 2017 and to verify the use of Mediation as a technique for solving conflicts related to water resources by the Sergipe River Basin Committee.

2. Methodology

The research was carried out in the Sergipe River Basin, located in the northeastern region of the state of Sergipe, arranged in the geographic coordinates quadrant with latitudes 10°08'00" and 11°04'00" S, and longitudes 36°50'00" and 37°50'00" W, and has an area of 3,753.81 km², involving the State of Bahia. The State of Sergipe comprises an area of 3,672.62 km², corresponding to 16.70% of the Sergipe territory (Sergipe 2010; Aguiar Netto and Moura Junior 2011).

This watershed covers the municipalities of Riachuelo, Malhador, Laranjeiras, Nossa Senhora Aparecida, Moita Bonita, Nossa Senhora do Socorro, São Miguel do Aleixo, Santa Rosa de Lima totally inserted in the Watershed and the municipalities of Aracaju, Barra dos Coqueiros, Areia Branca, Carira, Feira Nova, Divina Pastora, Frei Paulo, Ribeirópolis, Graccho Cardoso, Rosário do Catete, Itabaiana, Santo Amaro das Brotas, Itaporanga D'Ajuda, São Cristóvão, Nossa Senhora da Glória, Siriri and Nossa Senhora das Dores, partially inserted in the Watershed (Sergipe 2010).

The watershed has been undergoing an intense urbanization process and this is due in large part to the insertion of the capital of the state of Sergipe in the watershed, as well as the intense trade and large number of industries surrounding the Aracaju region, including the municipalities of São Cristóvão and Nossa Senhora do Socorro (Sergipe 2002).

In order to discuss the various interests focused on the multiple uses of water, the Sergipe River Basin Committee was created by State Decree 20.778, of June 21, 2002, which, according to art. 5 of this decree, must be integrated by 3 (three) sectors, represented by the public power, users and civil society

entities linked to water resources, adding a total of 48 (forty eight) members (Sergipe 2002), and one of its main attributions is to act in the first administrative instance in the resolution of conflicts related to water resources.

The temporal delimitation of the study was made after analysis of the Climate Report from 2000 to 2017, which demonstrated the variability of rainfall by regions in Sergipe. The report was made available by the Secretary of State for Urban Development and Sustainability, through the Center for Weather and Climate Analysis and Forecasting, Meteorology and Climate Change. Thus, the temporal delimitation of the study was comprised of the years 2003, 2004, 2012, 2013, 2014, 2015, 2016 and 2017, since in the years 2003, 2012, 2014 and 2016 the pluviometric indexes of the Coastal, Agreste and Sertão regions of the State of Sergipe, were negative, besides presenting a water deficit (Costa 2017) and the year following each year with a registered water deficiency was the period established for the possible conflicts related to water resources to come to the knowledge of the Sergipe River Basin Committee.

In order to identify possible conflicts related to water resources in the Sergipe River Basin during the delimited study period, the board of the respective river basin committee was requested to make available the minutes of the ordinary and extraordinary meetings. The minutes were also analyzed with the objective of verifying if there was the use of Mediation as a technique for resolving conflicts related to water resources by the Sergipe River Basin Committee.

The methodology used for the elaboration of this work was of an applied nature, since it intended to provide knowledge that could be used in practice and could also be directed to the resolution of specific issues (Lakatos and Marconi 2011).

In order to achieve the established objectives, the qualitative method was used, since it does not emphasize the enumeration or quantification of the data found, but it evidences the relevance of the information that is extracted through the critical analysis of the documents used in the research (Lakatos and Marconi 2011).

As for the procedure, the research was documentary, since several sources were used such as the minutes of the meetings of the Sergipe River Basin Committee, its Internal Regulations and the Climate Report that analyzed the variability of rainfall by regions in Sergipe from 2000 to 2017 (Lakatos and Marconi 2011).

The research was bibliographic, as it allowed obtaining various information and data found in numerous publications, in order to collaborate in the construction of the theoretical reference that refers to the object of study presented in this research (Gil 2010).

3. Results and discussion

The minutes number of meetings recorded in 2003, 2004, 2012, 2013, 2014, 2015, 2016 and 2017 was 26 (twenty-six) ordinary meetings, 6 (six) extraordinary meetings and 1 (one) thematic meeting (Figure 1).

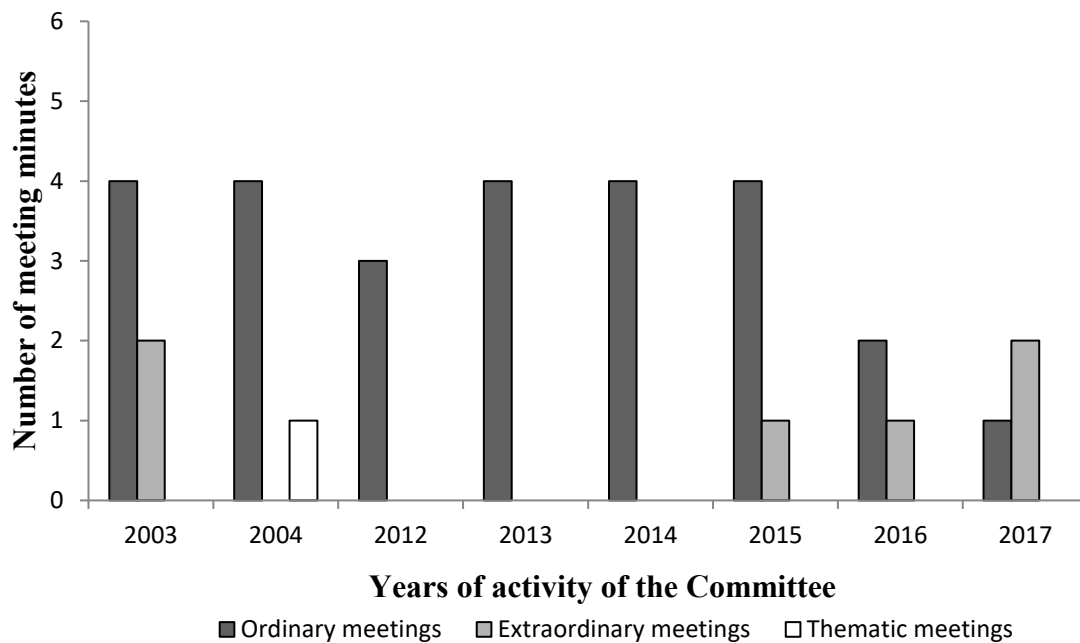


Figure 1. Number of minutes of ordinary, extraordinary and thematic meetings held by the Sergipe River Basin Committee in 2003, 2004, 2012, 2013, 2014, 2015, 2016 and 2017.

It was observed that the number of ordinary meetings in the years 2012, 2016 and 2017 was below the number established in Art. 38, item I of the Internal Rules of Procedure of the Committee, since they must meet ordinarily four (4) times a year. The number of ordinary meetings provided for in Article 38, subsection I of the Internal Rules of Procedure of the Sergipe River Basin Committee was reached in 2003, 2004, 2013, 2014 and 2015.

Only two ordinary meetings were held in 2016 and only one ordinary meeting in 2017, this fact that can cooperate significantly in the absence of denunciations, as well as possible discussions and resolutions of conflicts that may be occurring within the watershed.

Costa et al. (2011), studying the sub-basin of the Poxim River, identified the occurrence of environmental impacts resulting from anthropic actions in areas with riparian forest, deposition of garbage on the river banks, dumping of domestic and industrial effluents, as well as agricultural activities, proving the existence of actions that negatively impact the environment within the Sergipe River Basin. According to Figueiredo and Maroti (2011), there is a greater chance of conflicts related to water resources in the Sergipe River Basin, because the city of Aracaju, capital of the state, is inserted in the watershed.

It should be noted that in 2003, four ordinary meetings and two extraordinary meetings were held, totaling six (6) meetings throughout the year and representing the largest number of meetings held in all the years under review. In 2016 and 2017, as previously stated, the number of meetings was reduced to two ordinary meetings and one extraordinary meeting in 2016 and one ordinary meeting and two extraordinary meetings in 2017.

This difference between the number of meetings that took place in the years mentioned may be related to the difficulties faced by the different management of the Committee. Porto and Porto (2008) reported that there are difficulties in implementing decentralized and shared management in the committees and these

difficulties vary according to the articulations among the various sectors related to water resources.

Through the analysis related to the conflicts that were reported and recorded in the minutes of the Sergipe River Basin Committee meetings, no records of conflicts were found through the minutes of the meetings held in 2003. However, at the ordinary meeting held on May 8, 2003, in the city of Malhador/SE, the presentation of the Project Recovery of the Cajueiro dos Veados Stream was made, demonstrating the concern with the maintenance of water production in the Basin. Although there is no report of conflict in these minutes, according to Hora (2004), since 1996, some farmers had already reported the existence of environmental problems related to soil handling for agricultural activities in the area of the Cajueiro dos Veados Stream, located in the city of Malhador/SE, which caused a situation of environmental degradation that generates damage both to agricultural activity and to the water quality of that spring.

Still in the year 2003 it was identified in the minutes of the extraordinary meeting, occurred on June 09, 2003, in Aracaju/SE, the proposal of a member of the Committee to be created an organ with the objective to leave the Committee apt to the management of conflict.

The need and importance of training Committee members for conflict management was demonstrated, a fact that is confirmed in the environmental perception study conducted by Figueiredo and Maroti (2011) with the Sergipe River Basin Committee from 2008 to 2010, where the need was identified for continuous technical training and educational work in order to improve the training of its members to ensure that its members know the issues necessary for their deliberations.

Analyzing the minutes of the ordinary meeting held on April 13, 2004, in the city of Aracaju, Sergipe, it was observed that there was the presentation of a report with statements and photos explaining the environmental situation of the Rivers Sal and Cotinguiba, both affluents of the River Sergipe and, among the problems presented, were highlighted as more worrying, the pollution of Rio do Sal with the undue occupation of its banks with the construction of housing, in addition to silting up and pollution generated by domestic dumping directly into the river by the population, as well as industrial dumping from the Pinheiro Plant and the Santista Textile Factory. It was also highlighted that this report would be a denunciation report and that it should be accepted and given the necessary guidelines to solve the problem.

According to the Qualitative Diagnosis of Integrated Urban Water Management in the Metropolitan Region of Aracaju, the Sergipe River Basin contains areas of 26 municipalities, including the municipalities of Aracaju, Barra dos Coqueiros, Nossa Senhora do Socorro and São Cristóvão, which make up the metropolitan region of Aracaju and, because of this, has a significant demographic density in urban areas and, consequently, concentrates several problems related to water resources in the state of Sergipe (Sergipe 2010).

Analyzing the Minutes of the ordinary meeting held on March 27, 2012, in the city of Carira / SE, it was found that a representative of the Agricultural Development Company of Sergipe made an explanation about the River Sergipe, showing photos that portray the worrying situation that is the River Sergipe in this municipality, aggravated mainly by extensive corn plantations, indiscriminate use of pesticides and chemical inputs. The fact mentioned in these minutes was emphasized by the work developed by Araújo et al (2016), where it was evidenced the increase in corn production of approximately 5000% between 2003 and 2013 in the municipality of Carira, Sergipe.

From the analysis of the minutes of the meetings that took place throughout 2013, no records of conflicts related to water resources were identified.

At the regular meeting held on October 14, 2014, in the city of Aracaju/SE, a representative of the Superintendency of Water Resources, in her presentation, spoke about the formation of watershed committees and demanded that their main function was to resolve conflicts arising from water use.

It is possible to notice through the register above that the Sergipe River Basin Committee, despite having attribution for the resolution of conflicts related to water resources, has not focused its actions to fulfill this function. Gutiérrez (2006) also understands that the main function of the Committees is to At the ordinary meeting that took place on June 16, 2015, in the city of Itaporanga D'Ajuda/SE, a participant of the meeting explained about the volume of water existing in Brazil and in several regions of the state of Sergipe and informed that the population needs to do something to reduce conflicts and increase harmonious coexistence, given the increasing decrease in the volume of water offered and population growth. faced by the Committees, such as the difficulty of recognition and legitimacy by the public authorities of the decisions issued, in addition to the technical limitations that hinder decision-making on certain matters.

At the ordinary meeting that took place on June 16, 2015, in the city of Itaporanga D'Ajuda/SE, a participant of the meeting explained about the volume of water existing in Brazil and in several regions of the state of Sergipe and informed that the population needs to do something to reduce conflicts and increase harmonious coexistence, given the increasing decrease in the volume of water offered and population growth.

The increase in consumption of natural resources to supply this demand, especially the use of water, generates a pressure that can lead to immeasurable negative impacts on water resources, such as its scarcity both in quantity and quality available for consumption, a factor that already occurs in several parts of the planet, including Brazil (One and Albuquerque 2018).

At the extraordinary joint meeting with the Watershed Committees of the São Francisco River, the Japarutuba River and the Piauí River, which took place on November 19, 2016, in the city of Aracaju/SE, a representative of the Water Resources Superintendence spoke about the training of Committee members developed by the National Water Agency and what points to work on such as capacity, skills, management, finances, mediation and arbitration of conflicts.

Through the analysis of the minutes in the period delimited in this research, few conflicts were reported and in none of the cases was it reported what would be the referrals given by the committee to these problems. There was also no mention of the use of mediation as a method of resolving conflicts related to water resources recorded in the minutes of the committee meetings. Nevertheless, through the above report, it was possible to perceive that there is recognition by some members of the Committee of the Sergipe River Basin Committee of the need for a more active posture regarding the resolution of conflicts related to water resources in its area of coverage, and also that there is recognition of the possibility of using new methods of conflict resolution, such as conflict mediation, as well as the training of its members to be able to use it.

The use of conflict mediation by the Watershed Committee complies with the principles, objectives and foundations of the National Water Resources Policy, since through it, the management of water resources is able to provide multiple use of water, besides having the watershed as a territorial unit for the implementation of the National Water Resources Policy and the performance of the National Water

Resources Management System, also allowing the management of water resources to be decentralized and have the participation of the Public Authorities, users and communities.

According to Vasconcelos (2008), mediation is a non-hierarchical means of dispute resolution, where two or more people, with the help of a third party, the mediator, who must be impartial, freely chosen or accepted by the parties involved and capable (with the technical competence to do so), narrate the problem, discuss constructively and seek to identify common interests, possibilities and possibly sign an agreement. Law 13.140/2015 provides in the sole paragraph of Article 1st, that "Mediation is considered the technical activity performed by an impartial third party without decision-making power, which, chosen or accepted by the parties, assists and encourages them to identify or develop consensual solutions to the controversy" (Brazil 2015).

Thus, Almeida, Pantoja and Pelajo (2015, p. 282) inform that "the new Civil Procedure Code has kept pace with society's advances and is aligned with the most modern techniques of alternative conflict resolution [...]".

The Watershed Committee can use mediation to carry out its role in the management of conflicts related to water resources, given the advantages offered by this method of conflict resolution. The speed and effectiveness of its results, the reduction of emotional shock and financial expenditure, the preservation of intimacy and secrecy, the simplification of dialogue, the formation of cooperative scenarios, and the improvement of relationships due to the transformation of relationships are among the main advantages of this mechanism (Mendonça 2004).

Letting conflicts related to water resources be resolved or not within the Judiciary may lead to even more serious problems for the environment. Aspects such as the slowness of the decisions made by the Judiciary, either due to the large number of cases submitted to its appreciation, as well as the fact that there is little technical training for the resolution of environmental disputes in this area, besides the difficulty of the parties involved in the conflict to comply with such determinations, since they are imposed decisions, lead to the conclusion that it is necessary for the Hydrographic Basin Committee to act in the resolution of conflicts related to water resources and even if methods are used that make society's participation in decisions about water resources effective.

About the possibility of using self-compositional means in the resolution of environmental conflicts, asserts Figueiredo (2013, p. 153).

"Coexistential justice perfectly adapts to the solution of conflicts in the socio-environmental sphere, whose relations are complex and long-lasting, so that the use of the preventive tools of the controversy proves to be more efficient in meeting the principles of precaution, prevention and intergenerational equity that guide the guardianship of the environment".

At the regular meeting held on April 4, 2017, in the city of Aracaju/SE, no reports of conflicts were identified, but one member reported that he feels weakness and difficulty in dealing with some issues, due to the complexity and lack of coexistence with certain situations.

The difficulty of some Committee members in dealing with the conflicting situations arising from the use of water was perceived, even though it is a topic that is hypothetically recurrent in the Committee's

deliberations. This difficulty, according to (Ramos 2005; Leite 2015), proves that although the Committee is seeking new institutional mechanisms, such as new methods of conflict resolution, it still has difficulties in carrying out its activities, which in some cases may be due to the prevalence of decisions determined in favor of the interest of a certain group and specific segments, as well as may be related to the organization of the Committee, lack of knowledge of the information of the Basin itself by the members, lack of resources and qualified members.

The Sergipe River Basin Committee should not allow the perpetuation of attitudes that they propose to modify and innovate. In this sense, the Committee must continuously train its members, avoiding factors such as lack of technical qualification and information about the region that comprises the Watershed to be a decisive factor in the implementation of poor water management.

4. Conclusion

Through the analysis of the minutes of the meetings held in the delimited period, it was noted that there were few complaints about conflicts related to water resources in the Sergipe River Basin region. In most cases, there were no records of conflicts, but vague records of reports of problems occurring in the Basin region such as deforestation, river pollution, discharges of domestic and industrial effluents, which could be confirmed through the search for other studies conducted in the Basin.

Because of this, there is a need for the Committee to re-evaluate the process of drawing up its minutes, since there is an improvement in its preparation with the report of the problems that affect the basin region, it can use it to create an agenda of continuous actions with the objective of dealing with these conflicts, and it can also have control of what is being discussed and rediscussed by its members, in order to identify flaws and, of course, to see which actions are generating positive results for the management of water resources.

It is certain that the degradation of the environment that occurs in the watershed region, added to possible periods of water shortage, contributes to the existence of a series of disputes. The National Water Resources Policy gives the Hydrographic Basin Committee the competence to arbitrate, in the first administrative instance, the conflicts related to water resources and, because of that, it allows the creation of rules and public policies focused on water in a collective way, that is, democratically discussed by all members aiming at the prevention and consequent reduction of conflicts arising from the use of water.

The use of the Watershed as an instrument for managing water resources is advantageous because it brings society closer to the issues related to water resources, allowing the participation of the population in projects and decisions about water, in addition to providing a differentiated view of the environment in order to preserve it. In addition, the Committee can more easily evaluate, since it is restricted to a certain geographical area, what is the potential for development of a certain watershed, proposing the best ways to use the water resources of that location, with the least possible environmental impact, i.e., the use of water resources aiming at sustainability.

After the creation of the National Water Resources Policy there were several advances in water management. This advance, within the Sergipe River Basin Committee, could be identified in the analysis of one of the last minutes object of study, where a member of the Committee mentioned that there would

be training of its members by the National Water Agency, among these training courses, the implementation of conflict mediation.

The use of conflict mediation, a self-composed means of dispute resolution, allows the parties involved in the conflict to have the possibility of re-establishing communication between them and, in the end, obtaining an effectively fair solution. Thus, the agencies and all those involved in the dispute will be able to use it in order to speed up the resolution of these conflicts, since the problem is solved in the first administrative instance, which is under the jurisdiction of the Watershed Committees, and there will be no need to resort to lawsuits, which are generally lengthy, to resolve these types of cases, as well as to reduce the number of conflicts submitted to the Judiciary.

However, for the use of mediation as a method of resolution to be recognized, it is necessary that the Public Authorities and also the members of the Committee act to bring to the knowledge of the population in general the existence of other mechanisms of conflict resolution. Therefore, this role should be developed both at the state level, through the Judiciary itself, and at the non-state level, through the Watershed Committee, and the forms of dispute resolution should complement each other, but always seeking the use of mediation as a first measure.

5. Acknowledgments

Thanks to Sergipe State Research and Technological Innovation Support Foundation - FAPITEC for granting scholarship to the student Vanessa Gomes de Araújo, during the Graduate Program in Development and Environment - PRODEMA/UFS.

6. References

- [1] Aguiar Netto, A.O., Moura Junior, E.M.B. (2011). Conflitos ambientais e processos judiciais na bacia hidrográfica do rio Sergipe. *Scientia Plena*, 7(1):1-16.
- [2] Almeida, D.A.R., Pantoja, F.M., Pelajo, S. (2015). A mediação no novo código de processo civil. Rio de Janeiro: Forense.
- [3] Araújo, H.M.de, Oliveira, A.M.de, Cruz, R.da, Souza, A.C. (2016). O agronegócio do milho e a modernização agrícola na sub-bacia do rio salgado. *REGNE*, Vol. 2, N° Especial, 2016. Disponível em: <<https://periodicos.ufrn.br/revistadoregne/article/view/10502/7433>>. Acesso em 16 de junho de 2020.
- [4] Borba, N.Z., Bayer, D.A. (2015). A água como bem jurídico econômico. *TerCi – Temiminós Revista Científica*, 5(1).
- [5] Brazil. Lei nº 13.140, de 26 de junho de 2015. Dispõe sobre a mediação entre particulares como meio de solução de controvérsias e sobre a autocomposição de conflitos no âmbito da administração pública; altera a Lei no 9.469, de 10 de julho de 1997, e o Decreto no 70.235, de 6 de março de 1972; e revoga o § 2o do art. 6o da Lei no 9.469, de 10 de julho de 1997. Disponível em:

<http://www.planalto.gov.br/CCivil_03/_Ato2015-2018/2015/Lei/L13140.htm>. Acesso em 10 de junho de 2020.

[6] Câmara, A.F. (2006). Lições de Direito Processual Civil. VOL.I. 15 ed. Rio de Janeiro: Lumem Júris.

[7] Cintra, A.C.deA., Grinover, A.P., Dinamarco, C.R. (2004). Teoria Geral do Processo. 20. ed. São Paulo: Malheiros.

[8] Costa, C.C., Gomes, L.J., Almeida, J.A.P.de, Rocha, S.L.R. (2011). Ações impactantes nas matas ciliares da bacia hidrográfica do rio Poxim– SE. In: Encontro de Recursos Hídricos em Sergipe, 4, Aracaju: SEMARH/SRH, 2011. Disponível em: https://www.researchgate.net/publication/256186514_Acoes_impactantes_nas_matas_ciliares_da_bacia_hidrografica_do_rio_Poxim-SE. Acesso em: 22 de maio de 2020.

[9] Costa, O.A. (2017). Laudo Climatológico: Análise da Variabilidade das Chuvas por Regiões em Sergipe, de 2000 a 2017. Aracaju.

[10] Figueiredo, A.V.A., Maroti, P.S. (2011). Bacia Hidrográfica do Rio Sergipe - Significado, identidade e escolha de usos a partir da percepção dos membros do Comitê (Gestão 2008-2010). REDE - Revista Eletrônica do PRODEMA, Fortaleza, 7(2). Disponível em: <<http://www.revistarede.ufc.br/rede/article/view/167>>. Acesso em: 22 mai. 2020.

[11] Figueiredo, L.M. (2013). Mediação Ambiental: O Acesso à Justiça pelo olhar da extrajudicialidade. In: Monica Bonnetti Couto; Maria dos Remédios Fontes Silva; Miguel Kfoury Neto. (Org.). Acesso à Justiça I. 1aed.: FUNJAB, p. 144-169.

[12] Gil, A.C. (2010). Como elaborar projetos de pesquisa. 5. ed. São Paulo/SP: Atlas.

[13] Gutiérrez, R.A. (2006). Comitê Gravataí: gestão participativa da água no Rio Grande do Sul. Lua Nova, São Paulo, 69:79-121. Disponível em: < <http://www.scielo.br/pdf/ln/n69/a05n69.pdf>>. Acesso em: 25 de junho de 2020.

[14] Hora, F.M.D.da. (2006). Caracterização dos agroecossistemas da micro-bacia do riacho Cajueiro dos Veados, Malhador-SE. 2006. São Cristóvão. Dissertação (Mestrado em Agroecossistemas)-Universidade Federal de Sergipe. Disponível em: < http://www.dominiopublico.gov.br/pesquisa/DetalheObraForm.do?select_action=&co_obra=31698> Acesso em: 25 de junho de 2020.

[15] Lakatos, E.M., Marconi, M.deA. (2011). Metodologia científica. 6. ed. São Paulo: Atlas.

- [16] Leite, K.L.R. (2015). Os comitês de bacia hidrográfica e a gestão dos recursos hídricos no Brasil. Revista Jus Navigandi Teresina, ano 20, n. 4329, 9 maio 2015. Disponível em: <<https://jus.com.br/artigos/32873>>. Acesso em: 25 junho de 2020.
- [17] Leroux, A.D., Martin, V.L., Zheng, H. (2018). Addressing water shortages by force of habit. Resource and Energy Economics, 53, 42–61. doi:10.1016/j.reseneeco.2018.02.004.
- [18] Mendonça, Â.H.B. (2004). Uma visão geral de conceitos e aplicações práticas. 2. ed. MESC, Brasília: Projeto CACB/SEBRAE/BID.
- [19] One, G.M.daC., Albuquerque, H.N.de. (2008). Meio Ambiente: os desafios do mundo contemporâneo. Orgs. IMEA. João Pessoa, 2018. PORTO, M. F.; PORTO, L. Gestão de bacias hidrográficas. Estudos avançados, 22(63): 43 60.
- [20] Porto, M.F., Porto, L. (2008). Gestão de bacias hidrográficas. Estudos avançados, 22(63): 43 60.
- [21] Ramos, P.R. (2005). Modelo para outorga de uso da água utilizando a metodologia multicritério de apoio à decisão: Estudo de caso da Bacia Hidrográfica do rio Cubatão do Sul. 2005. 260 f. Tese (Doutorado em Engenharia de Produção) – Universidade Federal de Santa Catarina, Florianópolis – SC.
- [22] Sergipe, Decreto nº 18.806 de 12 de maio de 2000. Homologa o Regimento Interno do Conselho Estadual de Recursos Hídricos – CONERH/SE, e dá providências correlatas. Secretaria de Estado do Planejamento e da Ciência e Tecnologia – SEPLANTEC. Disponível em: <<https://sogi8.sogi.com.br/Arquivo/Modulo113.MRID109/Registro1329/documento%201.pdf>> Acesso em: 21 de junho de 2020.
- [23] Sergipe. Decreto n. 20.778, de 21 de junho de 2002. Institui o Comitê da Bacia Hidrográfica do Rio Sergipe, e dá providências correlatas. Secretaria de Estado do Meio Ambiente e dos Recursos Hídricos – SEMARH. Comitê da Bacia do Rio Sergipe, 2002 Disponível em: <https://www.semarh.se.gov.br/recursoshidricos/wp-content/uploads/2018/01/decreto_de_constituicao.pdf>. Acesso em: 21 de junho de 2020.
- [24] Sergipe. Lei nº 3.870/97, de 25 de setembro de 1997. Dispõe sobre a Política Estadual de Recursos Hídricos e o Sistema Estadual de Gerenciamento de Recursos Hídricos. Disponível em: <http://agenciapeixevivo.org.br/wp-content/uploads/2011/12/images_arquivos_legislacaoambiental_Sergipe_lei_n_3870.pdf>. Acesso em: 20 de junho de 2020.
- [25] Sergipe. Regimento Interno do Comitê da Bacia Hidrográfica do Rio Sergipe. Secretaria de Estado do Meio Ambiente e dos Recursos Hídricos – SEMARH. Comitê da Bacia do Rio Sergipe, 2002.

- [26] Sergipe. Secretaria de Estado do Meio Ambiente e dos Recursos Hídricos – SEMARH. Atlas Digital sobre Recursos Hídricos do Estado de Sergipe. Aracaju: Secretaria de Estado do Meio Ambiente e dos Recursos Hídricos/ Superintendência de Recursos Hídricos – SEMARH/ SRH, 2013. (CD-ROM)
- [27] Sergipe. Secretaria de Estado do Meio Ambiente e dos Recursos Hídricos – SEMARH. Elaboração do Plano Estadual de Recursos Hídricos: Caracterização e Diagnóstico Ambiental do Estado. [s.l.]: SEMARH, 2010.
- [28] Sergipe. Secretaria de Estado do Meio Ambiente e dos Recursos Hídricos – SEMARH. Gestão Integrada das Águas Urbanas da Região Metropolitana de Aracaju – Diagnóstico Qualitativo. Aracaju, 2010. Disponível em: <
https://www.semarh.se.gov.br/wp-content/uploads/2017/02/gestao_integrada_aguas_urbanas_aracaju.pdf
>. Acesso em: 23 de junho de 2020.
- [29] Sergipe. Secretaria de Estado do Planejamento e da Ciência e Tecnologia – SEPLANTEC. Superintendência de Recursos Hídricos – SRH. Gestão participativa das águas de Sergipe. Aracaju, 2002, p. 72. Disponível em: <
https://www.semarh.se.gov.br/recursoshidricos/wp-content/uploads/2018/01/publica%C3%A7%C3%A3o_cbh_vers%C3%A3o_final_com_capa.pdf
>. Acesso em: 21 de junho de 2020.
- [30] Vasconcelos, C.E. (2008). Mediação de Conflitos e Práticas Restaurativas. São Paulo: Método.
- [31] Yarshell, F.L. (2004). A reforma do Judiciário e a promessa de “duração razoável do processo”. Revista do Advogado, São Paulo, ano XXIV, 75:28-33.

Course of Engineering Project Management for Automatic Engineering

Xu Wang*, Xuwen Liu, Sha Xu, Jiao Luo

Mechanic and Automobile Engineering College,
Shanghai University of Engineering Science, Shanghai, 201620,
China

Abstract

For the new requirements of engineering certification, a modular teaching plan of engineering project management is proposed that is also combined with the professional features of vehicle engineering. Specifically, the teaching objectives of this course are established by engineering certification. Meanwhile, the course content is modularized and adopted different teaching method, such as lecture, interactive module, heuristic teaching method, etc. The improvement plan of course fully focuses on student-centered and output-oriented principle which strengthens the initiative of students to master basic theory knowledge. And it is helpful for students to have the ability to meet the engineering certification standards.

Keywords: module, project management, automatic engineering, engineering certification

1. Introduction

With the popularization and application of engineering project management in the enterprises, society's demand for talents with engineering project management knowledge and skills is also increasing. Engineering project management has become one of the mandatory courses for many colleges and universities to export talent^[1]. So the practical ability of engineering project management is not only one of the necessary skills for technical talents under market demand, but also emphasizes the application of knowledge, which is an important link in engineering technology talents' practical ability training^[2]. Especially, in the graduation requirements of the vehicle engineering major, it is clearly stated that students need to have project management capabilities, which is to understand and master engineering management principles and economic decision-making methods, and can be applied in a multi-disciplinary environment.

Project management is a comprehensive course that integrates engineering, management, technology, economics, laws and regulations, as well as theory and practice. It not only involves professional content such as engineering technology, personnel management, cost analysis, and risk avoidance, but also is closely related to national policies and regulations^[3]. For different majors, project management should have different training programs. For the enterprise management major, it focuses on theoretical research^[4]. And for the vehicle engineering major, it focuses on solving practical problems. However, these differences are not well reflected in the college's training program now. So in the teaching process of vehicle engineering project management courses, it need to pay attention on how to effectively improve the teaching efficiency and teaching quality and how to promote the good connection between students' professional qualities and the needs of vehicle companies. In this process, teachers need to establish a curriculum teaching program with professional characteristics.

2. Teaching Objectives

The teaching objectives of this course are as follows:

- a. Students have a sense of social responsibility and engineering professional ethics.
- b. Students have the economic management knowledge required for engineering work.
- c. Students have the management technology and skills related to the practice of mechanical engineering projects, and have a certain sense of innovation.
- d. Students understand the relevant policies, policies, laws and regulations of the automotive industry, and correctly understand the impact of automotive engineering on society.
- e. Students have engineering-related organizational management capabilities, communication and expression capabilities and team spirit.

Through the study of this course, the following effects would be achieved.

- a. Students understand the knowledge structure, capabilities and responsibilities of project management engineers, learn the domestic and international background and development trends of engineering project management, and make out the interrelationship between engineering project management and related disciplines and relevant theoretical knowledge.
- b. Students understand the organization, process and bidding management of projects.
- c. Students master the basic methods of investment control, schedule control and quality control in project management.
- d. Students understand relevant laws and regulations, combine practical issues, and have the initial ability to engage in project management.
- e. Students have certain organizational management, communication and expression, innovation and teamwork awareness.

Due to the orientation, teaching objectives and learning effects of the course, the teaching content and related resources are improved. Accordingly, based on the analysis and summary of teaching lessons, a variety of teaching methods should be used.

3. Contents Pattern Blocked

To desalinate inherent concept, course content carry out modular teaching based on course orientation and needs analysis. The project management knowledge system is divided into three major modules which are basic theory, case module, and application in background field. The block of basic theory includes project management overview, project organization, integration management, time management, quality control, cost management, human resource management, risk management, and purchasing management. Case module involves role play in project management, automotive product development, work breakdown structure, critical path, project risk identification, and project stakeholder analysis. The application in background field contents logistics project management, automobile project management, and mechanical R&D project management.

4. Diversified Teaching Methods

Due to the influence of traditional education and teaching concepts, teachers now basically use textbooks as the main materials when teaching engineering project management, and describe the theory knowledge by word in slam-teaching method. Because of the limitation of teaching concepts and sections, teachers pay too much attention to the theoretical knowledge and ignore the importance of practical teaching. This situation has greatly negative impacts on the overall development of students' engineering quality.^[5] Similarly, according to the principle of modular design, the teaching method is divided into four parts: lecture module, interactive module and assessment module.

4.1 lecture module

Teachers not only expand the scope of knowledge for students in the course, but also keep close to the professional knowledge. The content of the lecture should be state of the art technology, and not limited to textbooks. Teachers should initially determine the key contents of the course, teaching schedule and assessment mode.

4.2 Interactive module

Interactive sections in teaching could increase the students' participation and decrease the anxiety. Questions or group discussions^[6] are good way to enhance students' ability of analysis and summarization in a cheerful atmosphere. In the process of discussion or questioning, comparing the teacher's ideas, students could improve the ideas and form a rigorous thinking.

In this module, multiple teaching method could be adopted such as heuristic and role-playing which could consolidate and improve subsequent effects of learning from the experience.

To make the interaction effective, the module grouping method is needed which is shown in Fig 1.

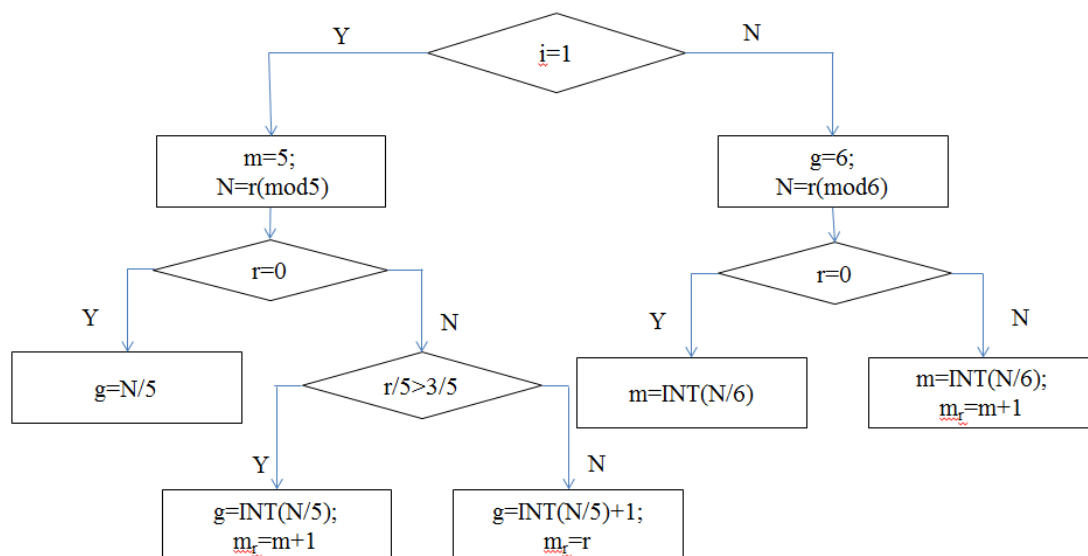


Fig.1 Grouping Method

Where i is serial number of teaching program, and $N \in [30,40]$ is the number of total students.

Respectively, g and m represent the number of groups and members in each group. m_r is the number of members in the special group.

Heuristic teaching method

According to the course content, two inspiration methods of discussion and question are adopted respectively. Heuristic method of discussion is to guide students to actively participate in classroom teaching activities on the basis of preview and students play the main role through discussion. For example, teachers release thinking questions before class and organize students to discuss in class in order to discover problems and solve problems. Heuristic method of questioning is that teachers ask students some questions about the key points and difficulties of the course content in class which is helpful for students to digest and consolidate the course content.

The teaching method of role-playing

The teaching method of role-playing is immersive learning which emphasizes students' direct participation and experiential teaching. To introduce the construction project into the school classroom simplify and transparent the complex and abstract management knowledge and theories. The students experience the whole process of engineering project management, and practice the project management theory. The whole class is divided into 6 project teams and the grouping method is shown in Figure 1 ($i=1$). Each team is responsible for one position as Table 1.

Table 1 Positions and Responsibility

Position	Responsibility
project manager	business and project planning
operation manager	operations and records
engineering manager	personnel and equipment
accounting manager	reports
procurement manager	raw material procurement and negotiation
assistant manager	project plan control

Through actual project management, everyone is immersed in a simulated engineering project to learn and communicate. In the process, lots of contents are involved, such as cost accounting and analysis, schedule planning, resource needs planning, construction organization design, materials management, etc. Compared with the traditional model, the teaching effect is good since students could get the preliminary application of the theoretical knowledge in engineering project management. Through the analysis of exchanges with students, students have high interest.

4.3 Assessment module

At present, the evaluation method used is still closed-book examination in most colleges and universities in China, and the content of the papers is basically theoretical knowledge that needs to be memorized.

Teachers will use this test as a basis to develop corresponding evaluation. This backward evaluation method has great limitations. In order to get good scores, students have to memorize various theories and formulas. This kind of assessment method has no way to reflect the true level of students, nor can it conduct a comprehensive assessment of students' practical ability, and the assessment results do not meet objective demands for teaching effects of this course.

In order to effectively improve students' practical ability and complete the part of engineering quality training, the teachers must emphasis on students' practical ability training and strengthen extracurricular design training.

The task-driven teaching method is adopted for the practical application to simulate a real project. When teaching related content of the project integration management in the course, the students are divided into small groups, see Fig 1 ($i=2$), and the project assignments which consistent with the classroom content are assigned. In order to have better understanding of the knowledge, students are responsible for a project from beginning to end, discuss and communicate with each other in group. They simulate each member of the project work and complete the formulation of project charter and project management plans. In the course of teaching, the teacher first briefly explains the knowledge involved, and according to the needs of the task, informs the students to look up relevant materials and complete the tasks. The task of each member is the assessment and training, and the requirements for students are high. First, they need to learn the relevant basic knowledge. Meanwhile the most likely problem in the team to complete the tasks is that one person does the whole project, and the others are little more than nameplates. Due to an ambiguous team's division of labor, it is easy to make the inappropriate evaluation in the assessment. In order to eliminate team members to shirk each other's tasks, the division of labor record sheet is introduced to clarify the difficulty coefficient of each member, and then score points is according to the completion situation.

5. Conclusion

Based on the background of engineering certification, the curriculum reform of Engineering Project Management still needs to optimize the teaching mode to improve the theoretical level of students and train students' ability of project construction management. Teachers are supervisors, emphasizing the student-centered open teaching ideology with output-based education which is to encourage students to think independently. In view of the modular curriculum content, appropriate teaching methods are adopted to improve students' ability of independent learning, knowledge application, teamwork and economic decision-making which meet the requirements of engineering certification training, and provide practical and feasible methods for transporting internationally-used technical personnel of project management.

Acknowledgements

The authors would like to thank the references for giving valuable comments and suggestions, which make us possible to improve the paper. Research is supported by Shanghai University of Engineering and Technology high-level & first-class undergraduate construction leading planned project--mechanical professional group construction.

Reference:

- [1] Tina Åsgård. Health, safety and environment in the teaching of project management. The case of bachelor education in construction engineering in Norway[J]. *Procedia Computer Science*, 2018, 138:688-696.
- [2] Yan Ma. The application of peer instruction in the practical teaching in colleges and universities[J]. *Higher Education of Sciences*, 2020(02): 107-110.
- [3] Natalie Ewin, Jo Luck, Ritesh Chugh, Jacqueline Jarvis. Rethinking Project Management Education: A Humanistic Approach based on Design Thinking[J]. *Procedia Computer Science*, 2017, 121:503-510.
- [4] Cano Moreno Juan David, Arenas Jos   M., S  nchez Victoria, Isl  n Manuel, Narb  n Juli  n. Methodology for quantitative evaluation of university teaching. Application to the subject of Project Management[J]. *Procedia Manufacturing*, 2019, 41:930-937.
- [5] Weidong Liu, Limin L, Jiangli Wu. Teaching reform in engineering management based on application oriented talents[J]. *Journal of Heilongjiang Institute of Technology*, 2015, 29(06):76-80.
- [6] Na Xu. Exploration on the construction of curriculum group of engineering project management based on CDIO [J]. *Value Engineering*, 2017, 36(4): 151-152.

Causes of Marital satisfaction and the criteria of choosing partners for marriage as Perceived by the People of Navrongo in The Upper East Region of Ghana

Joseph Akpadago

Department of Education

St. John Bosco's College of Education,

Post Office Box, 11, Navrongo-Ghana

0244138801/0203840444 Email: akpadagoj@mail.com

ABSTRACT

The study examined the causes of marital satisfaction and the criteria of choosing marriage partners as perceived by the people of Navrongo in the Upper East Region of Ghana. Data were gathered through the use of Marital Satisfaction Inventory (MSI). The sample size was 384 participants comprising 192 males and 192 females who responded to the Marital Satisfaction Inventory. The stratified and quota sampling procedures were used to select the respondents for the study. The study showed that some couples in Navrongo were not satisfied with their marriages as indicated by respondents to the MSI. Seven scales were used as indicators for marital satisfaction. These included, relationship, affection, love and appreciation, character, temperament, in-law issues, marital roles, and general evaluation. Couples would have been satisfied if the mean scores of the various scales were high enough to fall within the specified satisfied range. The study showed that many married couples chose their partners through courtship than those who were married through betrothal. In Navrongo, more females are betrothed than males and males prefer courtship to betrothal. On the other hand, many men chose their partners through courtship than their female counterpart. Marital satisfaction and the criteria of choosing a partner for marriage by respondents also showed that 86.17% of those who married through betrothal were not satisfied with their marriages whereas 90% of respondents who married through courtship were also not satisfied with their marriages. Only about 13.8% and 10% for respondents of betrothal and courtship were satisfied with their marriages respectively.

Keywords: Cohabitation, Elopement, Appellations, Fiancée, Fiancé

INTRODUCTION

Marriage according to the Oxford Dictionary (1998) is the legal union of a man and woman in order to live together and often to have children. According to Abudu (2008) “the traditional definition of a man getting into a union with a woman or several of them for the purpose of raising a family is still very popular worldwide” (p. 4). Explicitly and contrary to Abudu's assertion about marriage which could be accepted

in some communities of the African society, the exposition of marriage falls short of what modern Ghana and the laws of Ghana would celebrate as marriages. The court of Ghana accepts the concept of one man marrying one woman.

Marriage from the biblical point of view was instituted by God. In Genesis Chapter 2:18, God said, it is not good that the man should be alone; I will make him a helper as his partner. Marriage, to Akinade (1997), is the union and cohabitation of two people of the opposite sex with a permanent commitment to each other and their children when they are born and are dependent on them. Akinade's explanation of marriage would be contested by people who are of the same sex and yet cohabitate.

To Thompson and Hickey (1999) cohabitation is where two people live together without legal marriage. Marriage can be explained as the relationship between a man and a woman who have made a legal agreement to live together (Broderick, 1994). By implication, when a man marries a woman, they become a husband and wife. After marriage, couples would plan to have children and to raise them to the best of their ability till they become independent. According to Broderick, "most couples decide to marry because they love each other and want to spend the rest of their lives together" (p. 219). The foundation for successful should be love. These days, people marry because of materialism. In the event that the materials are no longer available, the marriage can break.

A contrasted view of marriage by Schwartz and Scott (2003) from the United States defined marriage as a legal contract between a woman and a man who are at a specified age and who are not already legally married to someone else. Schwartz and Scott expounded the understanding of marriage as a union between people that unites partners sexually, socially and economically; that is relatively consistent over time, and that accords each member certain agreed upon rights.

According to Glenn (as cited in Benokraitis, 2008), marital happiness decreases when couples experience poverty, job loss, and financial problems. Therefore it does not necessarily mean that marriage would make one happier than he/she is. With regard to marital happiness, Benokraitis indicated that "marriage itself isn't a magic potion that makes us healthier and happier" (p. 300). The quality of our marriage is much more important for our health than simply getting or being married. Medical memo (as cited in Benokraitis, 2008) reveals that the quality of the marriage is critical for our emotional and physical well-being.

Marrying the right person can result in much personal happiness and fulfilment. Marrying the wrong person may result in much misery (Rice, 1999). Cultures all over the world vary according to their traditions and so is the marriage institution. Whereas in some cultures marriages are arranged for the couples, courtship is an individual affair in some cultures. Dating is a method by which young men and women get to know one another, learn to get along socially, and select mates by mutual choice. Before World War 1, courtship consisted mainly of the young man paying formal visits to the young woman and her family (Rice). According to Saxton (as cited in Rice, 1999), dating is unknown in China and India and it is forbidden in Egypt, Saudi Arabia, Iran, Libya and other Muslim countries. In India, sociologists estimated that 95 percent of all marriages were still arranged, including the majority of those among the educated class (Bumiller, 1992).

Microsoft® Student 2009 [DVD] (2008) stated that:

Betrothal, engagement or formal agreement to marry, may take the form of a verbal promise or a written contract between two individuals. The betrothal is an ancient custom dating from biblical times when marriages were arranged by one's parents or guardians. During the Middle Ages arranged betrothals were used to strengthen royal dynasties, establish diplomatic alliances, and increase estates and fortunes. Until recent times, it remained common for parents to arrange marriages in much of the world, especially the Eastern and Muslim countries. In some societies, the custom still exists.

This system of the process of marriage is similar to betrothal among some communities in the Northern part of Ghana where parents give their young daughters, as a promise for marriage, to a young man sometime before the girl is matured for marriage. Elopement is another form of marriage where a lady runs away to marry secretly. In a more primitive type of elopement, the fiancé makes arrangement with strong men who will whisk the fiancée away to the fiancé's house and the old ladies vocalize appellations and the marriage is assumed effected. Elders from the fiancé clan are sent to the kidnapped lady's family to officially inform the parents that their daughter is married to their son.

Statement of the Problem

Haseley (2006) conducted a research in America on the topic, marital satisfaction among newly married couples: associations with religiosity and romantic attachment style. Adonu (2005) on his part looked at, psychosocial predictors of marital satisfaction in British and Ghanaian cultural settings. Alder (2010) adds up to the number of researchers who delved into marital satisfaction. Adler's thesis topic was Age, education level, and length of courtship in relation to marital satisfaction.

Marital satisfaction is not a new topic in research because apart from the few foreign researches that were stated earlier, some researchers within Ghana also did work on marital satisfaction. Examples include Ahene (2010) who worked on the marital satisfaction: A case study of spouses in Cape Coast Pentecostal and Charismatic churches. Ackumey (2011) also did similar work but the topic was the impact of conflict management of marital satisfaction among couples of Duakor, Cape Coast, Ghana. However, I wish to focus on the criteria of choosing a partner for marriage among the people of Navrongo and as to whether it is betrothal or courtship that is mostly. The study also investigates whether the criteria of choosing a partner for marriage by the people of Navrongo brings about marital satisfaction.

Purpose of the Study

According to Berkman and Syme (as cited in Sarafino, 2002), "marriage is often thought to convey a protective health benefit to people by providing social support. Consistent with this idea, studies have found that married people live longer than divorced and never-married individuals" (p. 104). This statement can only be true if there is harmony in marriages. The objectives of the study were therefore to examine the criteria for choosing a marriage partner and the causes of marital satisfaction among the people of Navrongo in the Upper East Region of Ghana

The following research questions were formulated to provide a focus for the study:

Research question 1: What criteria are mostly considered in choosing a partner for marriage among the people of Navrongo?

Research question 2: What are the causes of marital satisfaction as perceived by married spouses in Navrongo?

Significance of the Study

Rice (1999) indicates that all couples, both those who achieve marital success and those who do not, experience problems and stress in and outside their relationship. A distinguishing factor between the two couples is that those who experience successful marriages are able to solve their problems and manage marital stress properly.

It is hoped that counsellors would benefit from the findings of this study in the following way; equipping themselves with specific issues in marriages that can bring about marital satisfaction. Counsellors will use those issues like relationship, affection, character, in-law issues, marital roles, temperament and general evaluation to guide their clients in their marriages.

It is also hoped that when spinsters and bachelors come across this material they would be informed about the criteria of choosing a marriage partner; that is, marriage through betrothal and marriage through courtship so that they can make an informed decision on which way to go. The study is also focused on whether the criteria of choosing a marriage partner has anything to do with marital satisfaction.

Delimitation of the Study

The study basically focused on the criteria of choosing a partner for marriage and the causes of marital satisfaction as perceived among the people of Kassena-Nankana Municipality. The study was delimited to only two criteria of choosing marriage partners. The study also examined how married couples were satisfied in their marriages. The scope of this research did not include measures to make those who were not satisfied to attain satisfaction. Other districts in the Upper East Region of Ghana were not included in the study.

Limitations of the Study

When this research work was embarked upon, some possible challenges were envisaged to militate against the smooth conduct of it. However, what was encountered far exceeded what was anticipated. Some of the limitations included communication barrier, poor attitude of some respondents such as not willing to cooperate and lack of accessibility to some communities.

Measures were put in place to engage interpreters for interpretation during the administration of the inventory. However, any time interpreters were not available, work slowed down considerably especially communities where the illiteracy rate was high. Though measures were put in place to engage interpreter during the administration of the inventory, it was possible that some of the concepts were misconstrued. It was easy administering the Marital Satisfaction Inventory to the literate population than their illiterate counterparts. It must be stated that, generally, administering the inventory took a longer time than expected because of the determination to ensure that all items on the inventory were well ticked. With support from the research assistants, all items were cross checked to ensure a completed inventory.

Poor attitude of some of the respondents during the administration of the inventory was frustrating and discouraging. We took our time to explain our mission to respondents but some felt that the exercise

would generate income and so they needed their share of the money. Others also complained that the questions were invading their privacy. For instance, some respondents exclaimed especially among the illiterate folks when questions that were asked bordered on sexual satisfaction. This brought about time wasting because we had to spend more time on one respondent trying to explain our mission again and again while reassuring confidentiality in order to obtain responses. The way and manner by which they answered created suspicion as to the authenticity of responses.

Accessibility to some communities was also a challenge. We could not use a car to some of the places. The journey that was shorter ended up being longer because the alternative routes were very far. Areas that we decided to use bicycles led to energy sapping and serious fatigue. Procedure for sampling was slightly affected because of poor road.

METHODOLOGY

The study was designed to ascertain the criteria of choosing marriage partners and marital satisfaction as perceived by couples in the Kassena-Nankana East Municipal. The research design used for the study was the survey design. Survey research involves acquiring information about one or more groups of people about their characteristics, opinions, attributes or previous experiences. This is done by asking the respondents questions and tabulating their answers (Leedy & Ormrod, 2010). Leedy and Ormrod further indicated that the ultimate goal is to learn about a large population by surveying a sample of that population and this approach is called a descriptive survey.

Population

The population for the study constituted married people in the Kassena-Nankana Municipal. The total population of married people in the municipal as stated in the 2010 Ghana Statistical Service report was 33,439. Kassena-Nankana municipal formally known as Kassena-Nankana East district was the place chosen for the study. Kassena-Nankana municipal is located in the Upper East Region. It is bordered by the Republic of Burkina Faso, and the Bolgatanga, Bongo, Builsa, Sissala and Mamprusi West Districts. It stretches for 55 kilometres from north to south and 53 kilometres from east to west. The capital town of Kassena-Nankana municipal is Navrongo.

Sample and Sampling Procedure

The sample size for the study was 384 respondents. Krejcie and Morgan (as cited in Cohen, Manion, & Morrison, 2007) posit that as the population increases, the sample size increases at a diminishing rate and remains constant at slightly more than 380 cases. The sample size of 384 which covered 35 electoral areas of the Kassena-Nankana Municipal of the Upper East Region of Ghana responded to the Marital Satisfaction Inventory. The stratified and quota sampling procedures were used to select the respondents to respond to the Marital Satisfaction Inventory in 35 zones. The respondents constituted 192 males and 192 females.

Instruments

The main instrument that was used to collect data was an adapted Marital Satisfaction Inventory (MSI). The Marital Satisfaction Inventory was designed for married couples to assist them find out the extent to which they were satisfied in their marriage. The instrument has two forms; thus Form A for men and Form B for women. Each of the forms contains 30 items, designed in a 4-point likert-type scale (Very True, True, Not True, and Not at all True). The instrument, however, has close-ended items on age, sex, religion, occupational status and two items which border on whether the spouse got married through betrothal or courtship.

The MSI has a scoring guide which breaks the MSI into seven (7) scales based on relationship, affection, (love and appreciation), temperament, In-law issues, marital roles and, general evaluation. In the MSI manual, the total score for the 30 items is 120 being the maximum score indicating very satisfied and a minimum score of 30 implying not at all satisfied. Two other bands (interval) between the maximum and minimum are not satisfied with an interval score of 46-75 and satisfied with an interval score of 76-105. Essuman (2010) further explained that couples with scores of 30-75 are in general not satisfied with their marriages. The instrument is categorised into seven scales and each scale has specific items peculiar to that scale which measures marital satisfaction for that scale. Depending on the mean that is obtained for the sub-total of that scale, marital satisfaction is thus determined. The table presented indicates categories of scales, their items and ranges for satisfied and dissatisfied.

Table 1: Scales Indicating Satisfied or Dissatisfied

Scales	Satisfied	Dissatisfied
1: Relationship (items 2,5,10,20,21,25)	16-24	6-15
2: Affection, love & appreciation (items 3,4,16,23,27)	13-20	5-12
3: Character (items 6,12,18,19,22,28)	16-24	6-15
4: Temperament (items 13,14,29)	8-12	3-7
5: In-law issues (items 11,17,24)	8-12	3-7
6: Marital roles (items 9,15,26)	8-12	3-7
7: General evaluation (items 1,7,8,30)	11-16	4-10

Table 1 shows the various scales and their items for marital satisfaction can be determined depending on the mean score that is obtained after computing all the items for a scale. For instance, items from the Marital Satisfaction Inventory on relationship include; 2, 5, 10, 20, 21, and 25. Therefore we generate relationship = marital2 + marital5 + marital10 + marital20 + marital21 + marital25. Generate relationship on satisfaction = 1 if relationship > 15 & relationship !=. Replace relationship on satisfaction = 2 if relationship < 16 & relationship !=.

Data Collection procedure

A pilot test was conducted in the Kassena-Nankana West district using the Marital Satisfaction Inventory in order to determine the reliability coefficient of the instrument and the appropriateness of the instrument. The Cronbach's Alpha obtained was 0.892 for N=30.

The data gathered for the study were scored and analysed statistically using the Statistical Package for Social Science (SPSS) software version 16. Data were analysed using SPSS version 16.0. Descriptive statistics (frequencies and percentages) were used to present data collected for the research.

RESULTS AND DISCUSSION

Research question 1: What criteria are mostly considered in choosing a partner for marriage among the people of Navrongo?

Research question 1 sought to find out the criteria of choosing a partner for marriages as engaged in by the people of Navrongo. Table 2 shows frequencies and percentages of the criteria of choosing partner for marriage of respondents.

Table 2: Criteria of choosing a partner for Marriage of Respondents

Criteria of Marriage	Frequency	Percentage
Betrothal	94	24.48
Courtship	290	75.52
Total	384	100

As to how the people of Navrongo marry, Table 2 shows 384 respondents out of which 94 respondents representing 24.5% marry through betrothal while 290 respondents representing 75.5% marry through courtship. This shows that majority of the people of Navrongo marry through courtship.

One major change of courtship is the increased opportunities for informal heterosexual contacts. High schools and colleges that used to be exclusively for men or women are now coeducational (Rice, 1999). Society has become more interactive in nature and for that matter suitors get the opportunity to go for dating and this explains why courtship as a method of choosing a partner in Navrongo is prevalent.

Although Table 2 reveals the proportions of the distribution of marriage through betrothal and courtship it is appropriate to know the nature of marriage by sex distribution. Table 3 indicates the nature of marriage and sex of respondents.

Table 3: Criteria of choosing a partner for Marriage and Sex of Respondents

Nature of Marriage	Male	Female	Total
Betrothal		55 (28.6%)	94 (24.48%)
	39 (20.31%)		
Courtship		137 (71.4%)	290 (75.52%)
	153 (79.69%)		
Total		192 (100%)	384 (100%)
	192 (100%)		

As shown in Table 3, more female of 55 respondents representing 28.65% married through betrothal than 39 male representing 20.3%. The criteria for choosing a partner for marriage is the reverse for courtship in terms of males and females. More male respondents of 153 representing 79.7% married through courtship whereas 137 female respondents representing 71.4 married through courtship. In Navrongo, more females are betrothed than males and males prefer courtship to betrothal. When it comes to choosing a partner for marriage, many people have their own orientation towards it. According to Les and Leslie (2001) people believe that successful couples are “meant to be” and “are made for each other. Gilford and Bengtson (as cited in Clements & Swensen, 2000) found no gender differences with regard to marital satisfaction.

Marital satisfaction and the method for choosing a partner for marriage was a relevant issue worth examining. Can it be said that if one chooses to marry through courtship and the other marries through betrothal one would be more satisfied than the other? Table 4 unfolded the profound method of choosing a partner for marriage; that is marrying through betrothal or courtship and marital satisfaction of respondents.

Table 4: Marital Satisfaction and Method of Choosing a Partner for Marriage of Respondents

Marriage	Satisfied	Not Satisfied	Total
Betrothal	13(13.83%)	81(86.17%)	94(100%)
Courtship	29(10.00%)	261(90.00%)	290(100%)
Total	42(10.9%)	342(89.1%)	384(100%)

Marital satisfaction and the method of choosing a partner for marriage by respondents as shown in Table 4 revealed that 86.17% of those who married through betrothal were not satisfied with their marriages and 90% of respondents who married through courtship were also not satisfied with their marriages. Only about 13.8% and 10% for respondents of betrothal and courtship were satisfied with their marriages respectively. There was no significant difference between betrothal and courtship as methods of choosing partners in terms of marital satisfaction. Marital satisfaction to Burr (1970) is a subjective condition in which an individual experiences certain degree of attainment of goal or desire.

Research question 2: What are the causes of marital satisfaction as perceived by married spouses in Navrongo?

In analyzing this research question, the researcher used Essuman's (2010) 'score ranges'. According to Essuman, counselling is based on certain seven scales which he outlined as follows: relationship, affection, (love and appreciation), character, temperament, in-law issues, marital roles and general evaluation. He indicated the criteria for score ranges of “satisfied” or “dissatisfied”.

Table 5: Indicators of Marital Satisfaction among Respondents

MSI	N	Mean	Total Scores of Respondents
Relationship	384	12.0	4611
Affection, love & Appreciation	384	9.6	3677
Character	384	11.9	4575
Temperament	384	5.4	2088
In-law Issues	384	5.5	2112
Marital Role	384	6.0	2308
General Evaluation	384	6.9	2667

The overall mean score was 57.4 (total scores of respondents / N)

Table 5 shows the mean scores of all the seven scales specified in the Marital Satisfaction Inventory as; relationship 12.0, affection, love and appreciation 9.6, character 11.9, temperament 5.4, in-law issues 5.5, marital roles 6.0, and general evaluation 6.9. The satisfied ranges which is the criterion for determining marital satisfaction are; relationship 16-24, affection, love and appreciation 13-20, character 16-24, temperament 8-12, in-law issues 8-12, marital roles 8-12, and general evaluation 11-16 (Essuman, 2010). Considering the means for the scales, couples on the whole were not satisfied with their marriages, in all the scales (factors). Therefore, none of the seven factors brought about marital satisfaction. The overall mean score of the seven factors was found to be 57.4 which indicated that in all couples in Navrongo were dissatisfied with their marriages.

Baron and Byrne (1991) assert that “though jealousy can clearly poison a relationship, most marital unhappiness does not result from anything so specific” (p. 294). What this means is that couples can be discontented with their marriage without anything so glaring as the possible cause.

Many things improve in relationships, but things become more difficult. Every successful marriage requires necessary losses, and in choosing to marry, you inevitably go through a mourning process. For starters, marriage sometimes means giving up a carefree lifestyle and coming to terms with new limits. It means unexpected inconveniences (Les & Leslie, 2001).

Table 6 indicates marital satisfaction according to what respondents ticked. Frequencies and percentages are used in this Table.

Table 6: Marital satisfaction according to Respondents

Marital Satisfaction	Frequency	Percentage
Satisfied	42	10.9
Not Satisfied	342	89.1
Total	384	100

Marital satisfaction as shown in Table 6 reveals that out of 384 respondents, 342 representing 89.1% were not satisfied with their marriages. It is also shown that only 42 respondents representing 10.9% were satisfied with their marriage. Minority (10.9%) of married peoples of Navrongo indicated they were satisfied with their marriages. As to the extent to which couples are satisfied with their marriages, the study confirmed that about 90% of spouses were not satisfied. This findings probably confirms what Glen indicated. According to Glenn (as cited in Benokraitis, 2008), marital happiness decreases when couples experience poverty, job loss, and financial problems.

Marriage does not erase personal pain, insure financial security, or eliminate loneliness, because people get married primarily to further their own well-being, not to take care of their partner's needs. The bad traits and feelings one carried around before marriage remain as one leaves the wedding chapel (Les & Leslie, 2001). People need to learn to make their marriage work, for successful marriages have no automatic button to press.

Conclusion

The study sought to assess the criteria that are mostly considered in choosing a partner for marriage as well as the causes of marital satisfaction as perceived by married spouses among the people of Navrongo.

The findings revealed that courtship as a method of choosing a partner was more profound than betrothal in Navrongo. Many people marry through courtship than betrothal.

Factors such as relationship, affection, love and appreciation, character, temperament, in-law issues, marital roles and general evaluation were the parameters used to evaluate couples level of satisfaction. Individually, some respondents were satisfied. However, on the whole these could not yield any marital satisfaction of couples in Navrongo. Couples were not satisfied in the following areas; relationship, affection, love and appreciation, character, temperament, in-law issues, marital roles, and general evaluation.

REFERENCES

- Abudu, A. O. (2008). *Getting married? Staying married?* Accra: Creative Opportunities.
- Ackumey, G. J. A. (2011). *The impact of conflict management of marital satisfaction among couples of Duakor, Cape Coast Ghana: A group guidance approach*. Unpublished master's thesis, University of Cape Coast, Cape Coast.
- Adler, E. S. (2010). *Age, education level, and length of courtship in Relation to marital satisfaction*. Unpublished master's thesis, Pacific University.

- Adonu, J. K. (2005). *Psychosocial predictors of marital satisfaction in British and Ghanaian cultural settings*. Unpublished Doctoral thesis, School of Social Sciences and Law Brunel University.
- Ahene, J. C. (2010). *Who worked on the marital satisfaction: A case study of spouses in Cape Coast Pentecostal and Charismatic churches*. Unpublished master's thesis, University of Cape Coast, Cape Coast.
- Akinade, E. A. (1997). *Towards satisfactory marriage*. Oyo: Caltop Publications.
- Baron, R. A., & Byrne, D. (1991). *Social psychology: Understanding human interaction* (6th ed.). Needham: Simon & Schuster, Inc.
- Benokraitis, N. V. (2008). *Marriages and families: Changes, choices, and constraints* (6th ed.). New Jersey: Pearson Prentice, Inc.
- Broderick, C. B. (1994). *The world book encyclopaedia*. Chicago: World Book, Inc.
- Bumiller, E. (1992). First comes marriage-Then maybe, love. In J. M. Henslin, (Ed.), *Marriage and family in a changing society* (4th ed.), (pp. 120-125). New York: The Free Press.
- Burr, W. R. (1970). Satisfaction with various aspects of marriage over life cycle: A random middle class sample. *Journal of Marriage and the Family*, 32(1), 29-33.
- Clements, R., & Swensen, C. H. (2000). Commitment to one's spouse as a predictor of marital quality among older couples. *Current Psychology*, 19(2), 110-120.
- Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). New York: Routledge Falmer.
- Essuman, J. K. (2010). *Marital satisfaction inventory*. Cape Coast: Counselling Centre, UCC.
- Ghana Statistical Service (2012). *2010 Population and Housing Census*. Accra: Sakoa Press Limited.
- Haseley, J. L. (2006). *Marital satisfaction among newly married couples: Associations with religiosity and romantic attachment style*. Unpublished Doctoral thesis, University of North Texas, Texas.
- Leedy, P. D., & Ormrod, J. E. (2010). *Practical research: Planning and design* (9th ed.). New Jersey: Pearson Education, Inc.
- Les, P., & Leslie, P. (2001). *Saving your second marriage before it starts*. Michigan: Zondervan.
- Microsoft® Student 2009 [DVD] (2008). "Betrothal." Redmond, WA: Microsoft Corporation.
- New Revised Standard Version (1990). *The Holy Bible*. Nashville: Thomas Nelson Publishers.
- Oxford Dictionary. (1998). *D K Oxford Dictionary*. London: Oxford University Press.
- Rice, F. P. (1999). *Intimate relationships, marriage, and families* (4th ed.). Mountain View: Mayfield Publishing Company.
- Sarafino, E. P. (2002). *Health psychology: Biopsychosocial interactions* (4th ed.). New York: John Willy & Sons, Inc.
- Schwartz, M. A., & Scott, B. M. (2003). *Marriages and families* (4th ed.). New Jersey: Pearson Education Inc.
- Thompson, W. E., & Hickey, J. V. (1999). *Society in focus: Introduction to sociology* (3rd ed.). New York: Addison Wesley Longman, Inc.

Families, Generations and Intergeracionality In Net Modernity

Camila Kuhn Vieira

MSc student of the Postgraduate Program (PPG) in Sociocultural Practices and Social Development, University of Cruz Alta (UNICRUZ). CAPES scholarship holder. Graduation in Nursing – UNICRUZ, Rio Grande do Sul, Brazil. E-mail: camilakuhn1994@hotmail.com

Carine Nascimento da Silva

MSc student of the Postgraduate Program (PPG) in Sociocultural Practices and Social Development, University of Cruz Alta (UNICRUZ). CAPES scholarship holder. Graduation in Physiotherapy - UNICRUZ, Rio Grande do Sul, Brazil. E-mail: kaca_nascimento@hotmail.com

Ana Luisa Moser Keitel

MSc student of the Postgraduate Program (PPG) in Sociocultural Practices and Social Development, University of Cruz Alta (UNICRUZ). Purse fee CAPES. Law graduation - UNICRUZ, Rio Grande do Sul, Brazil. E-mail: analuisakeitel@hotmail.com

Adriana da Silva Silveira

MSc student of the Postgraduate Program (PPG) in Sociocultural Practices and Social Development, University of Cruz Alta (UNICRUZ). Rio Grande do Sul, Brazil. E-mail: adri01rp@gmail.com

Solange Beatriz Billig Garces

PhD in Social Sciences. Professor of the Postgraduate Program in Sociocultural Practices and Social Development at the University of Cruz Alta - UNICRUZ. E-mail: sgarces@unicruz.edu.br

Patrícia Dall'Agnol Bianchi

PhD in Biological Sciences. Professor of the Postgraduate Program in Sociocultural Practices and Social Development at the University of Cruz Alta - UNICRUZ. E-mail: pbianchi@unicruz.edu.br

Marcelo Cacinotti Costa

Doctor of Law. Graduate Program in Sociocultural Practices and Social Development at the Cruz Alta University - UNICRUZ. E-mail: marcosta@unicruz.edu.br

University of Cruz Alta, Rio Grande do Sul, Brazil.

Abstract

We are experiencing a period of accelerated socio-cultural, political and economic changes that are reflected in practically all social institutions, including the family. This is a secular social institution, which reflects the evolution of society. There is still resistance to “idealizing” the family as the “sphere of care

and love". However, it is known that the traditional family of the 19th century gave way to the nuclear family and that, at the same time, it gives way to families with different backgrounds. Also noteworthy are the transformations that occur in complex and liquid society, as highlighted by authors such as Morin and Bauman. In this sense, these transformations also occur in the social institutions that compose it, among them the family nuclei and other social spaces where different generations are inserted, especially with the increasing presence of elderly people. Therefore, with so many important social issues involved in these relationships (society-family-aging and intergenerationality), these reflections are considered to be extremely relevant.

Keywords: society; family; aging; intergenerationality;

1. Introduction

We are experiencing a period of accelerated socio-cultural, political and economic changes that are reflected in practically all social institutions, including the family. This is a secular social institution, which reflects the evolution of society. There is still resistance to "idealizing" the family as the "sphere of care and love". However, it is known that the traditional family of the 19th century gave way to the nuclear family and that, at the same time, it gives way to families with different backgrounds.

The liquidity of life, as referred by Bauman (2001), also has an effect on the rigid functionalist family structure, which today is undone by separations, (re) marriages, marriages between partners of the same sex, among many other possibilities. In addition, all families, practically have the presence of elderly or very elderly components, due to the extension of the population's years of life.

These are, therefore, possibilities of coexistence between different generations and, which cause conflicts in certain situations, because it is in the family where there are the greatest indicators of violence against the elderly, in all its nuances, be it mistreatment, exploitation, neglect and even physical violence. Although, socially and legally, there is a predictability that the family will be the "nest of love and care", usually sponsored by "caregiver" women, currently the cultural change in the social role of women in the last 50 years has brought consequences in these new family formations and it was, one of the causes of the deconstruction of this traditional model of functionalist family.

With the urban advance, the demographic changes caused especially by birth control, infant mortality and the control of contagious infectious diseases, and the democratic opening of the country, countless institutional spaces began to experience intergenerational exchanges never seen before. Also, the various changes brought about in family formation, especially due to the female role and sexual and gender diversity, brought important intergenerational exchanges.

Therefore, the objective of this work is to reflect on the theme of aging, supporting family arrangements and intergenerational generations.

2. Methodology

This research is characterized as a reflection through bibliographic review, linked in the discipline of Citizenship and Social Insertion for Elderly Populations originated from the Post-Graduate Program in

Sociocultural Practices and Social Development of the University of Cruz Alta - UNICRUZ and the Interdisciplinary Group of Studies of Human Aging - GIEEH.

This article is structured based on the theoretical basis of Bauman and Morin, for the discussion on the liquid and complex society; authors like Ana Amélia Camarano; Alda Britto da Motta who discuss situations relevant to aging in families; Miriam Lins de Barros, Eduardo Bittar and Miriam Goldemberg, who bring the discussions about family and intergenerationality.

3. Results and Discussions

3.1. The accelerated process of population aging

Population aging, since the last century, has resulted in accelerated demographic changes, caused by medical developments, improvements in health conditions and basic sanitation (CAMARANO, 2014). Among the main demographic changes, the decline in birth and mortality in all age groups is highlighted, as highlighted below in the projections of the Brazilian Institute of Geography and Statistics - IBGE:

[...] The population aged 60 or over goes from 14.2 million in 2000 to 19.6 million in 2010, and is expected to reach 41.5 million in 2030 and 73.5 million in 2060. Over the next 10 years, an average increase of more than 1.0 million elderly people annually (IBGE, 2015, p.146).

Based on Camarano and Mello (2010, p.14), the growing increase in the elderly population:

[...] it occurs in a context of marked structural changes in families, resulting from changes in nuptiality, the fall in fertility and the massive entry of women into the labor market. This entry affected traditional gender contracts, where the woman was the caregiver and the man, the provider. Today, Brazilian women are increasingly assuming the role of provider; their income was responsible for 40.9% of the income of Brazilian families in 2009, while still maintaining responsibility for the care of dependent members.

Family relationships have changed over the years, mainly with the decline in fertility and the insertion of women in the labor market, such changes have brought new forms of family arrangements along with the current demographic scenario. Currently, basically all families have elderly components (60 to 74 years old) and often elderly (75 to 90 years old) or even, these two stages of aging together, such as, for example, the interaction of young people / children with grandparents and great-grandparents in the same household. This “position of the elderly in the home can be considered an indicator of their empowerment or their fragility and dependence [...]” (CAMARANO; KANSO; FERNANDES, 2016, p.71).

An indicator of frailty, whether physical or mental, whether financial or social, is the proportion of elderly people in the condition of other relatives, that is, elderly people living with children, sons-in-law or daughters-in-law, nephews or other relatives. This proportion was higher among women, because as they live longer, they take care of their husbands, and when they die, they go to live with children or other relatives (CAMARANO; KANSO; FERNANDES, 2016, p.72).

Thus, one of the fundamental aspects about the diversity of this social group, that is, the elderly

population, was debated by the Human Rights Secretariat of the Presidency of the Republic, which highlights the increase in intergenerational families:

This phenomenon is due to the increase in life expectancy, but also to the new configurations of the contemporary productive world. Many unemployed, underemployed young people earn very little, marry at an older age and leave home at a late age. These changes now allow three or even four generations to live together in the same home [...] (BRASIL, 2013, p.20).

These changes in family groups are portrayed by Bauman (2008, p.35) "[...] This situation has changed and the crucial ingredient of the change is the new 'short-term' mentality that has replaced the 'long-term'. Marriages 'until death do us part' have become a rarity". Collaborating with Bauman (2008; 2001) in a society with liquidity in its human relations, Morin (2000) complements highlighting a complex society, thus modifying the paradigm of contemporary society.

Thus, "[...] due to this population aging, inclusive, social protection systems need to adapt to the new reality, providing support to families through social policies" (SILVA; DAL PRÁ, 2014, p. 100). Because, more and more, families are constituted according to the current population dynamics, especially when the elderly person has some dependencies related to locomotion, to manage their finances, self-care, among others, thus, the children end up paying a caregiver and / or bring this elderly to live in the same home, because supporting the parents / elderly is to follow the constitutional act, described in art. 229 "[...] older children have a duty to help and support their parents in old age, neediness or illness" (BRASIL, 1988, 01). However, public policies must establish more concrete and diversified social assistance for these families, considering this significant increase in the elderly population and intergenerationality.

3.2. Contemporary Families and Diversities in a Liquid Society

It can be said that the family consists of a group of people who may or may not have a degree of kinship with each other and live in the same house forming a home. In this sense, the family is united by multiple bonds capable of maintaining the members morally, materially and reciprocally for a lifetime and for generations. "[...] In addition to the fact that it is a natural institution, the family is also a social construction, as its roles vary according to specific circumstances and pressures of society" (BITTAR, 2007, p. 596).

According to Kroth (2008) the course of family life has always been and is marked by political, social and economic circumstances that characterize historical moments:

- *Extended and Patriarchal Family*: in which a wide range of people were under the authority of the same chief, usually the patriarch (father).
- *Nuclear and conjugal family*: unit made up of the heterosexual couple (male / female) and their dependent children. This family is called a traditional family at the same time because it is formed by the father and mother, united by marriage or de facto union, and by one or more children.

Contemporary families are composed by the diversity in family arrangements, both of a family extended by consanguinity, that is, the presence of elderly (grandparents), uncles and others, as well as families without a blood bond starting from a sentimental bond, such as families homoparental.

Oliveira and Santana (2014, p. 3,162) corroborate these statements by stating that: "[...] single-parent families, which are constituted by the affective-sexual relationship between two individuals of the same

sex, who are in a stable relationship, in the same dwelling, with or without the existence of children in this relationship” and add:

Starting from the patriarchal family, in which the man, head of the family, was in charge of making decisions about the direction of each member of this constitution, going through the 'fragmentation' of family life, where grandparents, parents, grandchildren, uncles, cousins and etc. , started to occupy different dwellings, each with their respective 'nucleus' of coexistence, until reaching various forms of family organization in contemporary times: single-parent families, reconstituted families, extended families and single-parent families (OLIVEIRA; SANTANA, 2014, p. 3,162).

"[...] Homoparenting has gained prominence in debates and on major social media, due to its characteristic considered unusual when compared to other families: the presence of two spouses of the same sex taking care of a child." (OLIVEIRA; SANTANA, 2014, p. 3,161). In this work published by Oliveira and Santana (2014, p.3.161) there was a “possibility of (re) flexing and (re) organizing the speeches involving homosexuality and the Brazilian family [...]”, a theme so necessary in these times of rapid social changes.

Therefore, with the changes in the composition of families and the consequent reduction in the number of children or as Silva and Dal Prá (2014, p. 101) place “[...] in the future, individuals who do not have children or close relatives will be elderly without the protection provided by its members, that is, they will not have the support of people united by blood or affective ties”.

These are, therefore, the main findings of a society in which Modernity in Liquidity is experienced, as defined by Bauman (2001). “[...] what is important to say is that the mark of modernity is the growing process of privatization of the family's functions, insofar as it is experiencing the vacancy of the public from within, and leaving for the public life a number greater of activities ”(BITTAR, 2007, p.595), as is the case of these situations in which we have previously presented.

Another finding is that:

There is a decrease in social cooperativism and solidarism that, in the first instance, are felt within the family itself. After all, modern morality (solid or traditional) has been converted into postmodern morality (liquid or individualizing), the latter capable of stimulating, at most, provisional 'communities' (BITTAR, 2007, p. 598).

That same author also states that “Liquid love is an exemplary demonstration of the dissolutive capacity of capital, which disrupts basic institutions such as the family. The volatility of contemporary capital gives a liquefied look to love” (BITTAR, 2007, p. 600).

3.3. Contemporary Intergenerational Experiences

The transformations of modern society, such as urbanization, the most demanding, competitive, low-wage labor market and computerization distance human and labor relations, as a consequence of this, the challenges that directly affect the structure and the family identity (BRITTAR, 2007).

Küchemann (2012) highlights these challenges in modern society, resulting from the rupture from the traditional family model to the contemporary model, in view of the diversity in the family composition,

such as: single-parent families, the insertion of women as protagonists in the labor market and no longer as home caregiver, among other challenges. Therefore:

[...] the family is in opposition to the public space, and shares space with the individual's personality and with the interested productivity of economic agents. For this reason, the family, in its surroundings, will have to represent something socially, so that, in the bourgeois era, an instrumental (sic) idea is projected in the marriage and in the feeling of the family nucleus, that both serve as support for relationships power, especially economic power (BRITTAR, 2007, p. 600).

Currently in Brazil, most households appoint the elderly as the head of the family, this fact is influenced by demographic, social and economic changes. Because “[...] although the majority of the resident children work, they have an average income lower than that of the elderly” (CAMARANO; EL GHAOURI, 2002, p. 19). The same authors also emphasize that “[...] the weight of the elderly's income in the budget of these households is significant, where the importance of the social benefit income is highlighted” (CAMARANO; EL GHAOURI, 2002, p.22).

There is still a smaller proportion of elderly people living with relatives / children, these elderly people being older, poor, with functional incapacity and worse health conditions, these are 'dependent' on the help of their children, this fact is explained, due to advancing age (longevity), predominance of chronic-degenerative diseases and reduced functional capacity. And, often, the younger elderly (60 to 65 years old) take care of the older elderly (over 75 years old) (CAMARANO; EL GHAOURI, 2002).

Generation, in a broad sense, represents the individual's position and performance in his age group and / or socialization over time. Hence the dynamic or unstable and plural sense that this condition, at the outset, represents. But what seems to many to be insecure of means or too short of achievements and, therefore, apparent existential, but also epistemological inexpressiveness - changing the age of each individual each year, as well as the gestation of a new generation with each new pulse of life social - in truth it means the structural becoming of a dimension of social life, which is, contradictorily, woven with affectivity and power relations (MOTTA, 2010, p. 226).

Human beings must prepare for old age, so that they can have a good social and affective life and continue to make their contribution to society. Happiness is achieved in the feeling of being, belonging, signifying, giving and fully enjoying the essence of life. It is necessary to combat the image of aging as a harbinger of death, but to face it as a natural process, a sequence of life (OLIVEIRA, 2002). For, old age does not mean only the predominance of “[...] diseases, prejudices and social instability, but also about happiness, pleasure and freedom (GOLDENBERG, 2011, p.82).

The family becomes a fundamental part of this process that occurs in old age, because in interpersonal relationships between all people there is always the opportunity for knowledge from the experience and that the older generations can leave as a legacy for the younger generations. It is clear that “[...] it cannot be denied, however, that the relationship between co-residence and levels of well-being depends on the

socioeconomic context, social policies and not only on individual characteristics and preferences" (CAMARANO; EL GHAOURI, 2002, p.24).

Living with the elderly in families, where there are strong affective bonds, can influence the education of their members, especially in the education of their grandchildren, as stated by Aguiar (2005, p.88), "There is no exclusive way to develop education, because every day at all times they mix life with education. The act of educating happens at different times in life without having a responsible person". According to Barros (1989, p.36), the transmission of symbolic goods / values between the elderly and their grandchildren are considered an inheritance for future generations, yet, "[...] they are rituals of introduction into social life and the adult world".

Thus, the elderly become more valued and recognized as "capable" of contributing to the development of children and adolescents and, on the other hand, children learn to respect and value the aging phase. In this perspective, Senator Omar Aziz (PSD / AM), through Senate Bill No. 501/2015, emphasizes that the theme of human aging should be part of the curriculum of Basic Education, establishing this Project in the Guidelines and Bases of National Education (FEDERAL SENATE, 2015).

The increase in life expectancy (longevity) means that families and other social spaces have experiences of living with different generations, in what is called intergenerational experiences. These intergenerational interactions of children / young people with the elderly are increasingly frequent and this causes them to strengthen and / or create socio-cultural practices valuing / respecting human relationships, but mainly, the process of aging, both in family arrangements and in social spaces, as explained above in the Senate Bill in Transition. Social policies must pay attention to these intergenerational interactions resulting from the Brazilian demographic dynamics, which makes us experience aging and its dimensions (culture, health, education, leisure, among others).

4. Conclusion

Family relationships have changed over the years due to the decline in fertility and the insertion of women in the labor market, such changes have brought new forms of family arrangements along with the current demographic scenario. The contemporary families of liquid and complex modernity highlighted by Morin and Bauman are composed of the diversity in family arrangements, both of a family extended by consanguinity, that is, the presence of elderly (grandparents), uncles and others, and of families without the bond blood starting from a sentimental bond, like homoparental families, families that went through separations even without blood ties, among others.

Currently, most families have an elderly component, whether they are elderly people's home (elderly as head of the family) and / or home with elderly (child or other relative as head of the family). In the vast majority, in Brazil, elderly housing prevails, in which the children (grandchildren, daughter-in-law) live with their parents / elderly, in which this fact is influenced by the economic and social factor.

However, there is still a smaller proportion of households with elderly people, which are influenced by the increase in life expectancy, predisposition to chronic-degenerative diseases and decreased functionality, which causes these elderly people, that is, older elderly / elderly (75 to 90 years old), are dependent on the help of the family member (child). In this sense, intergenerational meetings happen more frequently

through exchanges of experiences between the elderly and young people / children, both at home / family, and in other social spaces, such as school, neighborhood meetings, university, among others. Such coexistences of different generations strengthen socio-cultural practices by valuing and respecting human relationships, mainly helping to maintain dignity in old age, as old age is also considered as a phase of human development that presents more knowledge and cultural knowledge, and this should be shared by the present generations (young people), thus making the elderly more recognized and useful in inheriting symbolic goods for future generations, maintaining their well-being and dignity in old age.

5. Acknowledgement

We are grateful to the Graduate Program in Sociocultural Practices and Social Development at UNICRUZ and the Coordination for the Improvement of Higher Education Personnel (CAPES).

6. References

- [1] AGUIAR, Luciana. *Gestalt-terapia com crianças teoria e prática*. São Paulo: Editora Pleno, 2005.
- [2] BAUMAN, Zygmunt. **Modernidade líquida**. Tradução Plínio Dentzien. Rio de Janeiro: Jorge Zahar Ed. 2001.
- [3] BAUMAN, Zygmunt. **Sociedade Individualizada: vidas contadas e histórias vividas**. Tradução José Gradel. Rio de Janeiro: Jorge Zahar, 2008.
- [4] BARROS, Myriam Moraes Lins de. Memórias e Família. **Estudos Históricos**, Rio de Janeiro, v. 2, n.3, 1989. p. 29-42.
- [5] BRASIL. Constituição da República Federativa do Brasil de 1988. **Diário Oficial [da] República Federativa do Brasil**, Poder Executivo, Brasília, DF, 5 de outubro de 1988. Disponível em: <http://www.planalto.gov.br/ccivil_03/constituicao/constituicao.htm>. Acesso em: 18 março 2020.
- [6] BRASIL. Secretaria de Direitos Humanos da Presidência da República. **Brasil: manual de enfrentamento à violência contra a pessoa idosa. É possível prevenir. É necessário superar**. Texto de Maria Cecília de Souza Minayo. — Brasília [DF]: Secretaria de Direitos Humanos da Presidência da República, 2013. Disponível em:<<http://www.cedi.pr.gov.br/arquivos/File/CEDI/ManualViolenciaIdosogovfedweb.pdf>>. Acesso em: 19 março 2020.
- [7] BITTAR, Eduardo Carlos Bianca. FAMÍLIA, SOCIEDADE E EDUCAÇÃO: um ensaio sobre individualismo, amor líquido e cultura pós-moderna. **Revista da Faculdade de Direito da Universidade de São Paulo**, São Paulo, v. 102 p. 591 - 610 jan./dez. 2007.

- [8] CAMARANO, Ana Amélia Camarano (Org.). **Novo Regime Demográfico: uma nova relação entre população e desenvolvimento?** Rio de Janeiro: IPEA, 2014.
- [9] CAMARANO, Ana Amélia; EL GHAOURI, Solange Kanso. Famílias com Idosos: ninhos vazios? **Anais XIII do Encontro da Associação Brasileira de Estudos Populacionais**, Ouro Preto, Minas Gerais, Brasil de 4 a 8 de novembro de 2002.
- [10] CAMARANO, Ana Amélia; KANSO, Solange; FERNANDES, Daniele. **Brasil envelhece antes e Pós-PNI**. In: ALCÂNTARA, Alexandre de Oliveira; CAMARANO, Ana Amélia; GIACOMIN, Karla Cristina (Orgs.). **Política nacional do idoso: velhas e novas questões**. Rio de Janeiro: IPEA, 2016.
- [11] CAMARANO, Ana Amélia; MELLO, Juliana Leitão e. **Cuidados de longa duração para a população idosa: um novo risco social a ser assumido?** Rio de Janeiro: Ipea, 2010.
- [12] CASTILHO, Fernanda; NERING, Érica; PASSOS, Mateus Yuri. Reflexões teóricas sobre a produção científica: métodos de pesquisa social na área dos estudos de comunicação. **Conexão-Comunicação e Cultura**, USC, Caxias do Sul, v.14, n. 17, p. 83-107. Disponível em: <<http://www.ucs.br/etc/revistas/index.php/conexao/article/view/3015/2146>>. Acesso em: 31 março 2020.
- [13] IBGE. Instituto Brasileiro de Geografia e Estatística. **Mudança Demográfica no Brasil no Início do Século XXI: Subsídios para as projeções da população**. Estudos e Análises Informação Demográfica e Socioeconômica, n. 3, Rio de Janeiro: 2015.
- [14] GOLDENBERG, Mirian. Corpo, envelhecimento e felicidade na cultura brasileira. **Revista Contemporânea**, edição 18, v.09, n.02, 2011. Disponível em: <http://www.contemporanea.uerj.br/pdf/ed_18/contemporanea_n18_06_Mirian_Goldenberg.pdf>. Acesso em 31 março 2020.
- [15] KROTH, Vanessa Wendt. As famílias e os seus direitos no Brasil: Conceituação sócio-histórica, previsão legal e decisões judiciais do Supremo Tribunal Federal e Superior Tribunal de Justiça entre a Constituição Federal de 1988 e o Código Civil de 2002. **Dissertação de mestrado** do Programa de Pós-Graduação em Sociologia Política da Universidade Federal de Santa Catarina - Centro de Filosofia e Ciências Humanas, Florianópolis, 2008, f. 275.
- [16] KÜCHEMANN, Berlindes Astrid. Envelhecimento populacional, cuidado e cidadania: velhos dilemas e novos desafios. **Revista Sociedade e Estado**, Brasília, v.27, n.01, p.165-180, 2012.
- [17] MORIN, E. **Ciência com consciência**. Rio de Janeiro: Bertrand, 2000.

- [18] MOTTA, A.B. da. A atualidade do conceito de gerações na pesquisa sobre envelhecimento. **Revista Sociedade e Estado**, São Paulo, v.25, n.2, p. 225-250, maio-ago.2010.
- [19] OLIVEIRA, Rita de Cassia da Silva. Velhice: teorias, conceitos e preconceitos. **Rev. A terceira idade**, São Paulo, v.12, n. 25, p. 37-52, ago. 2002.
- [20] OLIVEIRA, A.C.R. de; SANTANA, P.M.S. de. Famílias Homoparentais: reflexões acerca do ser família na contemporaneidade. REDOR, 18 com o Tema: Perspectivas feministas de gênero: desafios no campo da militância e das práticas, 24 a 27 de novembro de 2014. **Anais do 18º REDOR...** Recife-PE: Universidade Federal Rural de Pernambuco, 2014.
- [21] SENADO FEDERAL, **Lei do Senado nº 501 de 2015**. Brasília [DF], 2015.
- [22] SILVA, A.; DAL PRÁ, K.R. Envelhecimento populacional no Brasil: o lugar das famílias na proteção aos idosos. **Argumentum**, Vitória (ES), v. 6, n. 1, p. 99-115, jan./jun. 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/>).

The Relevance of Learning Brazilian Sign Language to The Socialization of Deaf People

Ana Karina Verde Sampaio Mendes¹

Thelma Helena Costa Chahini²

Naysa Christine Serra Silva³

Abstract

Through Law nº 10.436 of April 24, 2002, the Brazilian Sign Language (LIBRAS) was made official as a way of communication and expression. From it, the visual-motor language system, with its own grammatical structure, constitutes a language system for transmitting ideas and facts, originating from deaf people communities in Brazil. The Brazilian Law for the Inclusion of Persons with Disabilities (Law nº 13.146 of July 6, 2015) establishes, among others, the provision of bilingual education, with LIBRAS as the first language, and the writing mode of Portuguese as a second language in bilingual schools and classes, as well as in inclusive schools. Within this context, a descriptive exploratory research was conducted at the Center for the Training and Support of Deaf People (CAS), in São Luís/MA. We aimed at investigating the relevance of learning Brazilian Sign Language in the socialization of deaf people, considering the perception of CAS students. Ten deaf students who were currently learning LIBRAS at the Center participated in the study, out of which seven were males and three were females aged between 17 and 36 years old. Data were collected through semi-structured interviews, considering the ethical procedures involving human beings. Results indicated that deaf students learning LIBRAS at CAS do so due to a number of reasons, such as communicating with hearing people, learning, working, having autonomy, being able to leave home, making friends, and spending time with other people. Within this context, the LIBRAS interpreter is of great relevance to the social, educational and professional inclusion of deaf people, as well as a communication mediator between deaf and hearing people. However, the LIBRAS teaching-learning process still requires a more efficient socialization and/or operationalization, aiming to reach society in general, and to include deaf people, thus breaking up myths, stigmas, prejudices, discriminations and unfavorable social actions related to the disability and their human potential. Employing a sensitive look and listening to the exclusion situations many deaf people are suffering is urgently needed to safeguard the respect to the human being and to the deaf people's culture.

Keywords: Deafness, Libras, Relevance, Learning, Inclusion.

¹ Mestre em Educação pela Universidade Lusófona de Humanidades e Tecnologias. Doutoranda em Ciências da Educação pela Lusófona de Lisboa/Portugal.

² Doutora em Educação com Pós-Doutorado em Educação Especial. Professora Associada da Universidade Federal do Maranhão.

³ Mestranda em Cultura e Sociedade pelo Programa de Pós-Graduação, Mestrado Interdisciplinar – PGCULT da Universidade Federal do Maranhão. Especialista em Educação Especial pela UEMA. Professora da SEMED – SJR/MA.

1 INTRODUCTION

Sign language is the communication channel used by deaf communities worldwide. However, it is not universal, as each country has its own language.

In 1857, invited by the Emperor D. Pedro I, Professor Ernet Hwet founded the National Institute for Deaf People Education (INES), which contributed to the creation of the Brazilian Sign Language – LIBRAS. However, it was only recognized as the language of the Brazilian deaf people's community and thus as the country's official second language over four and a half decades after its creation (Instituto Nacional de Educação de Surdos - INES, 2014).

According to Silva and Treml (2009), communication is the greatest challenge faced by the deaf, which is eased by using sign language, considered as a specific language of the deaf community. When hearing people learn LIBRAS, it enables the wider social inclusion of deaf people, considering their right to be included in society through language.

In this context, the primary objective of this study was to understand the relevance attributed to sign language learning in the socialization of deaf people, by assessing the perception of deaf students from the Center for the Training and Support of Deaf People (CAS) in the city of São Luís, Maranhão, Brazil.

2 METHODOLOGY

A descriptive exploratory research was conducted aiming for a qualitative approach. This was done according to Gil (2008), who reported that this type of research is appropriate for poorly known and poorly explored cases, while also allowing to describe the studied phenomenon.

In total, 10 deaf students who were learning Libras at CAS participated in the study. Out of that total, seven students were males and three were females, with ages ranging between 17 and 36 years. Regarding their level of education, one student was pursuing its undergraduate studies, four had finished only high school, and two had finished only elementary school. All three women had finished high school. Male students' occupation included packaging, vigilance and general services. Female students worked as supermarket cashiers and in general services.

To preserve their identities, participants in this study were identified as S1, S2, S3, S4, S5, S6, S7, S8, S9 and S10.

Data were collected through semi-structured interviews, because according to Triviños (1987) this technique "[...] favors not only the description of social phenomena, but also its explanation and the comprehension of its entirety [...] besides maintaining the conscious and active presence of the researcher in the process of gathering information" (p.152). Moreover, it allows more flexibility and the possibility for the interviewer to reformulate the question, aiming for a better comprehension by the interviewee. Two sign language interpreters helped with conducting the interviews.

All procedures followed the ethic criteria involving human beings, and participants signed an informed consent form agreeing to participate and aware that results would be published in scientific conferences and journals.

3 RESULTS AND DISCUSSION

Regarding interviews, when questioned about the reason that led them to learn Libras at CAS, data revealed that students (S1 and S8) wanted to break out of their usual routine and to be socially included, since having special needs does not make them disabled, despite the imposed social limitations. Participants (S2, S3, S4, S5, S6 and S9) were seeking to have autonomy, to be financially independent, to study, and build friendship bonds. Students (S7 and S10) reported that they wanted to go beyond, to be truly included, and to experience having the same rights and opportunities as those with no disability; they wanted to learn Libras to improve their self-esteem and to see themselves as participants in the social context together with other people, which is facilitated by learning the new language.

Based on that, it is important to cite Magalhães Junior (2007), who highlights the relevance of the Libras teaching-learning process within a social and educational context. In a similar manner, Fernandes (2008) explains that dominating a language is not limited to knowing a few words, but it also involves establishing a conversation and good communication. Therefore, data agree with this principle, since participants learn Libras to establish a communication with other deaf people, within a social, educational and professional context.

Furthermore, Pinto (2010) states that it is through the meanings created consciously between groups of society that interaction and interactivity happen, since people who seek to learn Libras are aware of the relevance of communication in a social, educational and professional context.

When asked whether they needed a Libras interpreter and, in case of positive answers, in which situation this interpreter was most required, participants were unanimous in saying that Libras interpreters are of paramount importance in teaching institutions, as they mediate interactions between deaf and hearing people, enabling communication and thus the access to formal education.

Additionally, it is also known that the relevance of interpreters extends to the social and professional contexts. As highlighted by Gesser (1971), "the interpreter is of great importance in regards to the interaction between deaf and hearing people" (p.47) since, although deaf people communicate mostly with their families and other deaf people, it is through the Libras interpreter that this communication reaches society in general.

Within this context, it should be highlighted that Libras has signs with contextualized meanings, thus increasing the importance of the interpreter in mediating communication between deaf and hearing people. It is also valid to mention Law nº 12.319 of September 1st, 2010, which brings regulations on the profession of Brazilian Sign Language (Libras) translators and interpreters. It also resolves that this professional is competent to interpret both languages simultaneously or consecutively, and is proficient in Libras and Portuguese translation and interpretation.

In its Article nº 6, the aforementioned Law assigns to the Libras translator and interpreter, in the exercise of their powers: to perform the communication between deaf and hearing people, deaf people and deaf people, deaf and deaf-blind people, and deaf-blind and hearing people to the oral language using Libras, and vice-versa; to interpret, in Brazilian Sign Language – Portuguese Language, educational and cultural activities developed at teaching institutions in primary, secondary and tertiary schools, as a way to enable the access to curricular contents; to act in recruitment processes of courses from teaching institutions

and of public tenders; to act in support of service accessibility and of core activities of teaching institutions and public offices; to provide their services in sworn testimonies, in administrative or police agencies.

In a similar manner, in its Article nº 7, the Law further states that the Libras translator and interpreter should exercise its occupation with technical rigor, caring for the inherent ethical values, for the respect to the human being and the culture of deaf people, as well as: for honesty and discretion, protecting the right for the confidentiality of the information received; for a practice free of prejudices related to origin, race, religious belief, age, sex or sexual orientation or gender; for the impartiality and fidelity to the contents fit for its translation; for the adequate posture and manner in environments it attends to as a result of its professional practice; for the solidarity and awareness that the right for expression is a social right, regardless of the social and economic condition of those who need it; for the knowledge on the specificities of the deaf people community.

As noted, the Libras interpreter and translator is of great relevance in the process of including deaf people in a social, educational and professional context. Therefore, investing in these professionals is necessary, in order for them to be able to mediate the communication between deaf and hearing people, as well as to guarantee the right for deaf people to exercise citizenship.

When asked whether there is anyone in their families who knows Libras, data revealed that within a family context, half of deaf students (S1, S2, S3, S4, S5) had only one family member who knew Libras. For the remaining half (S6, S7, S8, S9, S10), no other family member living with them knew the Brazilian Sign Language. It can thus be inferred that most deaf students have no one within their families who knows how to communicate with them through Libras, hampering the interaction and interactivity between them.

The communication between deaf and hearing people needs to be seen as one of the interaction priorities, mainly in primary socialization, since according to Stelling (1996) the basis of all knowledge we have comes from family. Furthermore, the beginning of lessons on attitudes, principles and values that guide us through our lives lies in our families. Therefore, the communication between deaf people and their family members should start in the family itself, and then be extended into the social, educational, and professional contexts, because this is how inclusion should be established.

Still pertaining to the context of communication between deaf and hearing people, the studies by Negrelli and Marcon (2006) highlight that “the participation of family in the deaf person communication through signs, will allow this individual to interact with the world, and will create a more pleasant and happy coexistence” (p.103).

In regards to the question on the importance of learning Libras, data showed that learning Libras is important for attending school and being able to study for the majority of deaf students, as well as for being able to work, taking classes, having friends, being understood, leaving home and visiting other places.

It is therefore noticeable that these students seek to learn Libras to communicate in a social, educational, and professional context, as well as to feel included in all parts of society. On this theme, Skliar (1998) highlights that the deaf person can and should be included in society through sign language, taking into consideration its potential and its rights as a citizen. Similarly, Laraia (2001) states that the person is a product of the environment it belongs to, its history can be written differently and the interactions between people can favor the acceptance of those with different needs and its potential development.

Law nº 10.436 of April 24, 2002, defines Libras as a way of communication and expression, in which the visual-motor language system, with its own grammatical structure, constitutes a language system for transmitting ideas and facts, originating from deaf people communities in Brazil.

Decree nº 5.626, of December 22, 2005, Chapter IV, Art. 14, §1º II, emphasizes that it is mandatory to offer the teaching of Libras from Early Childhood Education, and the teaching of Portuguese as a second language to deaf people.

Still on this matter, Damásio (2005) points that Libras enables the “linguistic, social, and intellectual development of those who use it as a communication tool, favoring their access to cultural and scientific knowledge, as well as the integration into the social group to which they belong” (p.61).

Similarly, studies by Carvalho (2007) found that “[...] Libras is the initial resource necessary for the true emancipation of the deaf and their educational and social inclusion” (p.33).

When asked about whether learning Libras is easy, data showed that participants found it to be easy, but that they need to pay close attention to the signs, since it takes time, patience and persistence to learn them. It is also perceived that the ease and/or desire in learning is directly linked to the need for communication in the social, educational, and professional contexts they are or need to be a part of.

Data agree with what Lacerda (2000) stated, when signaling that the deaf person should learn its language as soon as possible, so that the adaptation process is easier, not waiting for special situations to occur to then seek learning it.

In the same sense, Quadros (1997) reports that the process of learning Libras is similar to the process of learning Portuguese, as it also requires a lot of attention and practice. However, the ease is in the context of the person wanting to learn, its interests and/or objectives even in face of the complexity of both languages.

Therefore, Sacks (2010) is quoted for clarifying that “besides representing an achievement for the deaf, Libras is a stimulus for new achievements and for the broadening of horizons for deaf and hearing people” (p.82).

Regarding the question on the reason that most hearing people do not know Libras, data showed that according to the participants’ perceptions, this occurs for several reasons, among them: not needing the language to communicate; not liking Libras; finding it difficult and/or not wanting to learn.

Similarly, for most participants, hearing people do not seek to learn Libras because they do not need it to communicate, as they are able to speak and hear.

In regard to the importance of Libras for the interaction between deaf and hearing people, there is a great need for this language to be included in the curricula of all teaching institutions. Considering that the number of deaf people in Maranhão state has increased, this becomes even more important, which makes learning Libras necessary, aiming for the social, educational, and professional inclusion of the deaf person.

On this matter, Sá (2002) reports that there are still situations of great disadvantage for the deaf, who require more support so they can interact with everything in their surroundings.

Regarding the question of whether the deaf person can communicate with those who do not know LIBRAS, data revealed that, although three deaf students (S4, S5, and S6) answered yes, two of them said

that the communication is not understandable and confusing. For the remaining seven deaf students (S1, S2, S3, S7, S8, S9, S10), few and/or very few can communicate with those who do not know sign language.

Therefore, the facts allow us to infer that most deaf students have no understandable communication with those who do not know Libras.

It is therefore worth quoting Skliar (1998), who emphasizes that “when a deaf person is treated the same as a hearing person, it is in disadvantage” (p.37). To the author, learning sign language is just as important as learning English so the individual feels included, similar to when visiting an English-speaking country. If it is inclusion, and if inclusion is democracy, it is important that both deaf and hearing people learn Libras. Only then everyone will be treated the same, and only then the deaf person will be included into different contexts.

Still on this matter, Honora and Frizanco (2009) state that sign language is a living language like any other. Therefore, it is constantly transforming, always adapting to the inclusion conditions for understanding. In the specific case of deaf people, Libras needs to be seen as a necessity and, because of that, society needs to be aware about the relevance of everyone learning Libras, in respect to the inclusion of deaf people in their own country.

According to Goldfel (1997), most of society still has a negative view about deaf people, and many of their rights have not been respected. Therefore, the matter of inclusion should be faced seriously, since all persons must understand themselves within learning possibilities, and accept differences as an integral part of a large diverse group.

When asked about how they felt when speaking to those who do not know Libras, data showed a great dissatisfaction from deaf students in relation to hearing people who cannot understand Libras. This makes their lives more difficult, considering most of them feel lost in communication, and are upset for not feeling socially included.

When asked whether they have ever felt socially excluded due to a lack of communication with hearing people, participants were unanimous in saying that there have been several situations in which they needed to communicate with hearing people but an understandable communication between both parties was not possible because the latter did not know Libras. This led to the exclusion of the deaf person from a social and educational context.

On this matter, Lacerda (1996) emphasizes that deaf people use a language still unknown to most people and are therefore isolated despite having good relationships with those around them.

When asked whether a Libras interpreter was indispensable in educational institutions, results revealed that this professional is of extreme relevance, since the majority of deaf people are left on the margins of the information and/or knowledge in social, educational and professional spaces without the mediation it provides.

In this sense, it was found that the absence of a Libras interpreter in the educational context hampers learning for most students. Thus, it is noticeable that these interpreters are of paramount importance in the teaching-learning process of those students, and throughout their socialization in the world they are included in.

Therefore, we quote the clarifications obtained through the Portal Educação (2013), when emphasizing that the importance of the Libras interpreter is due to it performing

[...] the function of being the communication channel between the deaf student, the teacher, colleagues and the school team”, as well as “being a translator between people who share different languages and cultures, [...] however, its contact with the deaf student cannot be higher than the contact of the students with the class teacher (p.1).

However, according to Quadros (2007), the “acquisition process of the deaf in Brazil is completely atypical, since they are late Libras learners, which ends up hindering their written Portuguese learning, thus requiring a more reconsidered and significant pedagogical practice” (p.12).

In the same context, Silva (2007) raises attention to the fact that “pedagogical practices constitute the greatest problem in the schooling of deaf people” (p.21). The author further emphasizes that rethinking these practices is necessary for deaf students to know that their difficulties in reading and writing are not solely linked to the disability, but rather to the methodologies used in the teaching-learning process.

Therefore, in regards to the teaching-learning process of deaf people, Perlin and Miranda (2011), explain that it must include a linguistic and cultural proximity, so that learning is effective, as well as significant, i.e., respecting the human person and the culture of the deaf.

Regarding the question of what is missing for more people to learn LIBRAS, data showed that this is linked to understanding that this knowledge is very important to communicate with deaf people, as well as caring for the socialization process of the deaf person. This also includes respecting their culture, showing solidarity to their specific communication needs, wanting to learn and optimizing their time for learning.

In this sense, Stumpf (2009) is cited for explaining that people belong to organized groups and have their own form of communication. Therefore, there must be interest in learning Libras because deaf people must be able to understand what hearing people say and to communicate with them, considering that it is through interaction that everyone can live and talk understandably. Thus, Libras learning needs to be a conscious search to everyone towards inclusion.

4 CONCLUSIONS

Revisiting the proposed objective, which was to understand the relevance attributed to learning Libras, and considering the perception of students from the CAS in São Luís city, Maranhão, a diverse group was found seeking to learn Libras, which included deaf people, family members of deaf people, various professionals and other members of the community in general.

Deaf students learning Libras at the CAS do so for a variety of reasons, such as communicating with hearing people in study and work situations, having autonomy, being able to leave home, making friends and living with other people.

The Libras interpreter is of great relevance to the social, educational, and professional inclusion of the deaf, as well as in the mediation of communication between deaf and hearing people. The CAS is also of great relevance in this process.

Most family members of deaf students do not know Libras, which shows just how much deaf people are on the margins of interaction and interactivity during primary socialization, as in general society.

For most deaf students from CAS, learning Libras is easy but requires a lot of studying, attention, and practice, since the language has several signs, many of which are similar and highly variable.

According to deaf students, most hearing people do not know Libras because they do not need it to communicate and/or because they are not interested in learning it; because they have no deaf family members; and because of the difficulty in learning.

Communication between deaf and hearing people is hampered without Libras. On this matter, everyone highlights the importance of Libras in the social, educational, and professional inclusion of deaf people.

Deaf students feel lost and excluded when trying to communicate with those who do not know Libras. In specific cases, they also feel angry, upset, and sad, with the sensation that no one understands them.

All deaf students have already felt and still feel socially excluded due to the lack of communication and understanding between them and most hearing people. This occurs mainly due to situations where their human potential and/or abilities are discredited; due to the lack of interest of hearing people to communicate with them; due to the stigmas and prejudices related to hearing disabilities and/or deafness; due to the feeling of pity directed at them; due to the socially imposed neglect and limitations.

Summarizing the findings of this research, according to deaf students from CAS, the aspects missing for people to learn Libras are, first, wanting to learn, as well as feeling the need to communicate with deaf people and being sensitive about the exclusion condition which the deaf are in.

In this sense, including Libras is necessary both during primary and continued education, so the communication and/or interaction and interactivity between deaf and hearing people can be efficiently established in social, educational, and professional contexts.

Therefore, based on facts, the relevance of Libras in the process of including hearing disabled and/or deaf people in society cannot be dismissed. Moreover, we highlight the urgent need to debunk myths, stigmas, prejudices, and unfavorable social actions related to the disability and the human potential of those people.

We expect this study will bring attention to authorities and other people to develop a sensitive look and listen to the exclusion situation many deaf people are put in, directly linked to them being withheld from their right to exercise citizenship, from the respect for the human being, and for the culture of deaf people.

REFERENCES

CARVALHO, P. V. **Breve história dos surdos no mundo e em Portugal**. Lisboa: Surd'Universo, 2007.

DAMÁSIO, M. F. **Educação especial de pessoas surdas: uma proposta inclusiva** (Tese de doutorado). Campinas: Universidade Estadual de Campinas, 2005.

BRASIL. Decreto nº 5.626 de 22 de dezembro de 2005. Regulamenta a Lei no 10.436, de 24 de abril de 2002, que dispõe sobre a Língua Brasileira de Sinais - LIBRAS, e o art. 18 da Lei no 10.098, de 19 de dezembro de 2000. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2005/decreto/d5626.htm. Acesso em: 10 julho de 2019.

BRASIL. Lei nº 10.436 de 24 de abril de 2002. Dispõe sobre a Língua Brasileira de Sinais - LIBRAS e dá outras providências. Disponível em: http://www.planalto.gov.br/ccivil_03/leis/2002/110436.htm. Acesso em: 20 de julho de 2019.

BRASIL. Lei nº 12.319 de 1º de setembro de 2010. Regulamenta a profissão de Tradutor e Intérprete da Língua Brasileira de Sinais – LIBRAS. Disponível em: http://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2010/Lei/L12319.htm. Acesso em: 10 de julho de 2019.

FERNANDES, E. (Org.). **Surdez e bilinguismo** (2ª ed.) Porto Alegre: Mediação, 2008.

GESSER, A. **LIBRAS? Que língua é esta? Crenças e preconceitos em torno da língua de sinais e da realidade surda.** São Paulo: Parábola, 2000.

GIL, A. C. **Métodos e técnicas de pesquisa social.** São Paulo: Atlas. 2010.

GOLDFELD, M. **Acriança surda: linguagem e cognição numa perspectiva sócio interacionista.** São Paulo: Plexus, 2000.

HONORA, M., & Frizanco, M. L. E. **Livro ilustrado de língua brasileira de sinais: desvendando a comunicação usada pelas pessoas com surdez.** São Paulo: Ciranda Cultural, 2009.

INES. Instituto Nacional de Educação de Surdos. **Conheça o Ines.** Disponível em: <http://www.ines.gov.br/conheca-o-ines>. Acesso em: 20 julho de 2019.

LACERDA, C. B. F. **Os processos dialógicos entre aluno surdo e educador ouvinte: examinando a construção de conhecimentos** (Tese de doutorado). Campinas: Universidade Estadual de Campinas, 1996.

LACERDA, C. B. F. **A prática pedagógica mediada (também) pela língua de sinais: trabalhando com sujeitos surdos.** *Cadernos Cedes*, 20(50), 2000.

LARAIA, R. B. (2001). **Cultura: um conceito antropológico.** Rio de Janeiro: Jorge Zahar, 2001.

MAGALHÃES JUNIOR, E. **Sua Majestade, o intérprete: o fascinante mundo da tradução simultânea.** São Paulo: Parábola Editorial, 2007.

NEGRELLI, M. E. D., & MARCON, S. S. **Revista Ciência, Cuidado e Saúde**, 5(1), 98-107, 2006.

PERLIN, G., & MIRANDA, W. **A performatividade em educação de surdos**. In N. R. L. Sá. *Surdos: qual escola?* (pp. 101-117). Manaus: Editora Valer e Edua, 2011.

PINTO, G. U. **Imaginação e formação de conceitos escolares: examinando processos dialógicos na sala** (Tese de doutorado). Piracicaba: Universidade Metodista de Piracicaba, 2010.

PORTAL EDUCAÇÃO. **Importância do Intérprete de Libras**. Disponível em: <https://www.portaleducacao.com.br/conteudo/artigos/pedagogia/importancia-do-interprete-de-libras/41273>. Acesso em: 09 de junho de 2019.

QUADROS, R. M. **Educação de surdos: a aquisição da linguagem**. Porto Alegre: Artes Médicas, 1997.

SÁ, N. R. L. **Cultura, poder e educação de surdos**. Manaus: Editora da Universidade Federal do Amazonas, 2002.

SACKS, O. (2010). **Vendo vozes: uma viagem ao mundo dos surdos**. São Paulo: Companhia das Letras, 2010.

SILVA, A. da. **Atendimento educacional especializado**. São Paulo: MEC/SEESP, 2007.

SILVA, F. A. M., & Treml, R. A. **A inclusão do aluno surdo na rede regular de ensino**. *Uniletras*, 31(1), 11-31, 2009.

SKLIAR, C. (Org.). **A surdez: um olhar sobre as diferenças**. Porto Alegre: Editora Mediação, 1998.

STELLING, E. **O aluno surdo e sua família**. In: Instituto Nacional de Educação de Surdos (Org.). *Repensando a educação da criança surda*. Rio de Janeiro: INES, 1996.

STUMPF, M. Relato de experiências: a educação bilíngue para surdos: relatos de experiências e a realidade brasileira. In R. M. Quadros, & M. R. Stumpf. *Estudos surdos IV* (pp. 426-450). Petrópolis: Arara Azul, 2009.

TRIVIÑOS, A. N. S. **Introdução à pesquisa em ciências sociais: a pesquisa qualitativa em educação**. São Paulo: Atlas, 2008.

Nutritional physical examination: historical, methodological and applied approach

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.

Geanlucas Mendes Monteiro

Heath 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

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Vanessa de Souza Ferraz

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Flavia Soares Bezerra Okumoto Nery de Mello

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Dayane Aparecida Moisés Caetano Bottini

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Nelson Thiago Andrade Ferreira

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Tayla Borges Lino

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Juliana Vicente de Souza

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Gildiney Penaves de Alencar

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

João Vitor Alves dos Santos

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

Abstract

The historical interest in the use of physical evaluation skills in clinical settings gained new notoriety at the end of the 20th century with evidence that patients in intensive care units experienced increased morbidity and mortality related to poor nutritional status before and/or during their admission. This awareness of the adverse effects of malnutrition led to the need for screening and evaluation tools to identify nutritional risk. no clinical finding of EFN should be considered a diagnosis per se. It is academic, scientific and clinical consensus that its results should be interpreted as suggestive, being crucial to consider the other methods of clinical evaluation of the patient's nutritional status for the correct global nutritional diagnosis. However, the systematic and periodic repetition of the test may help to follow the evolution of the individual's nutritional status, especially in the long term. In summary, although it requires specialized training and continuous practice of the evaluator and/or the team – in addition to requiring complementary nutritional information – the physical nutritional examination can still be considered an effective adjuvant method in the clinical evaluation of the patient's nutritional status.

Keywords: Nutritional physical examination; Nutritional focused physical assessment; Nutrition care.

1. Historical perspectives

Nutritional care is described by the American Society for Parenteral and Enteral Nutrition (ASPEN) in four steps: nutritional assessment, diagnosis, intervention and monitoring. In Brazil, the systematization of nutrition care proposed by the Orientation Manual of the Brazilian Nutrition Association (ASBRAN, 2014), characterizes the nutritional physical examination (EFN), along with the global nutritional history and food history, as an integral part of the subjective sphere of the nutritional and metabolic state assessment. Thus, adding to objective methods (i.e., biochemical tests and anthropometric and body composition investigation), the physical examination contributes to the collection of the necessary information for clinical evaluation of the patient's nutritional status.

The historical interest in the use of physical evaluation skills in clinical settings gained new notoriety at the end of the 20th century with evidence that patients in intensive care units experienced increased morbidity

and mortality related to poor nutritional status before and/or during their admission. This awareness of the adverse effects of malnutrition led to the need for screening and evaluation tools to identify nutritional risk. The development of the Global Subjective Assessment emerged as a result of this process and, since its postulation in 1987 by Detsky and collaborators, already had the physical assessment as an execution component.

Still in historical perspective, the EFN itself had its scientific consolidation only in 1996 with the publication of the article “Nutritional Focused Physical Assessment” by Hammond Kathy and collaborators. Its structuring came in 1999 in the work, of the same authorship, entitled “The Nutritional Dimension of Physical Assessment” that brought, in the scientific scope, the first summary report of the materials and procedures necessary for its execution. However, in both texts the authors themselves recognize the previous existence of this method in clinical practice, although in a non-systematized way.

2. Methodological considerations

In the methodological sphere, Hammond's (1999) work postulates that physical evaluation focused on nutrition is composed not only by physical examination, but that it should be preceded by the evaluation of health history. Thus, after identifying the underlying mechanisms that can put the individual at nutritional risk, the physical evaluation can be conducted with specificity, avoiding unnecessary and/or uncomfortable procedures for the patient, besides possibly reducing the duration of the exam.

In a practical way, the EFN can be divided into two sequential investigative steps: 1) rapid proliferation tissues (TPR) and body systems; and, 2) fat mass, muscle and presence of edema. This ordering is indicated because it provides greater agility in the identification of clinical traces of malnutrition, since TPR tend to evidence nutritional deficiencies more quickly because they have a higher basal anabolic rate than other tissues.

As described in the literature already mentioned in this text, the execution of the EFN should begin after some basic preparatory procedures, of which the following should be highlighted: hygiene of the assessor and the equipment; use of IPE's whenever necessary; preparation of the environment checking factors such as temperature, humidity, lighting and noise emission; adequate physical comfort of the patient (the use of exam apron is indicated); and, promotion of the biopsychosocial welcome ensuring privacy, disposition and free will (no patient should be assessed against his/her will).

It is also recommended that the exam follows a predetermined evaluative direction (the “head-to-toe” technique). In addition, the use of a quick fill out form – preferably validated – is suggested to assist in the later complete detailed writing of the exam findings.

The procedure is based on the examiner's ability to look, hear, and feel, using all senses to distinguish variations from the usual physiological picture expected in healthy individuals. For that, four basic techniques are employed in its execution: 1) inspection; 2) palpation; 3) percussion; and 4) auscultation - in this order for all evaluations, except the abdominal one since percussion and palpation can alter intestinal sounds, and/or cause discomfort, interfering in the accuracy of the rest of the exam. In addition, the assessment of vital signs (i.e., blood pressure, heart rate, respiratory rate, and temperature) can also be considered.

At this point it is valid to clarify that, in Brazil, the Federal Council of Nutritionists establishes in Resolution number 304 of 26 December 2003 that the EFN is “carried out in a summary manner, using palpation and inspection”. This normalization corroborates what is observed in daily clinical practice, since percussion and auscultation are, when necessary for the examination, usually delegated to other team members (mainly doctors and nurses) since they require high training that is usually not implemented in the academic curriculum of nutrition.

With the proper training, qualification, experience, and taking into account the patient's global nutritional history, the evaluator – following the “head-to-toe” method – can employ the four techniques to perform the EFN in the following sequential steps: 1) general examination; 2) vital signs; 3) skin and attachments (i.e., nails and hair); 4) head; 5) eyes and nose; 6) mouth; 7) neck and thorax; 8) abdomen; and 9) musculoskeletal evaluation.

The general, oral cavity and abdominal examinations are of particular interest to the nutrition professional. In the first, it is possible to evaluate if the individual is thin, obese, his or her responsive state, body movements such as tremors whose presence may interfere with his or her ability to take food to the mouth, besides clinical signs such as jaundice; in the second, the presence of clinical signs such as glossitis, gingivitis, caries, malocclusion and/or the presence of the mouth-breather syndrome which, in general, may impair or even prevent chewing and/or physiological swallowing may be investigated; and, in the third, the investigation of intestinal motility (indirect evaluation of peristalsis) and abdominal contour that may reveal the presence of ascites (in the case of protruding abdomen) or depletive state (in the case of scaphoid abdomen) is highlighted.

Another factor widely evidenced in the scientific literature is the correlation between EFN findings and micronutrient deficiencies. These may play an important role in the development and/or progression of acute or chronic diseases and may also be associated with adverse changes in general health. According to the Special Report on the Right to Food (United Nations, 2016), that year there were two billion people with micronutrient deficiencies in the world, the most prominent being iron, vitamin A, and iodine deficiencies; and the article “Utilization of Nutrition-Focused Physical Assessment in Identifying Micronutrient Deficiencies” (ASPEN, 2015) states that for these deficiencies, the most common EFN findings are koilonychia; xerose and Bitot stains; and, increased thyroid gland, respectively.

Still in the methodological aspect of EFN, another important cut-off for nutrition professionals is the symptomatological analysis of protein-energy malnutrition during the examination, especially in hospital patients. The most serious forms of this pathology are kwashiorkor and marasmo. The first is usually evidenced in the EFN by the relatively normal body weight, skeletal muscle generally preserved, presence of edema of the lower limbs and, in severe cases, presence also of edema in the upper extremities and face; and, the second can be clinically manifested in the EFN by substantial loss of body weight, skeletal muscle and adipose tissue leading to caquexia. In both cases, however, the biochemical evaluation of serum proteins is essential for an effective analysis (decreased values for the first and in the normal range for the second).

It is also valid to mention that the diagnostic criteria for malnutrition are constantly reviewed (such as the GLIM method, proposed in 2018) and that, therefore, it is essential that the evaluator is in line with updated clinical guidelines when using the results of the physical examination.

3. Clinical applicability

As with the symptomatology of protein-energy malnutrition, no clinical finding of EFN should be considered a diagnosis per se. It is academic, scientific and clinical consensus that its results should be interpreted as suggestive, being crucial to consider the other methods of clinical evaluation of the patient's nutritional status for the correct global nutritional diagnosis. However, the systematic and periodic repetition of the test may help to follow the evolution of the individual's nutritional status, especially in the long term.

Its use and application, however, is not restricted to the nutritional field. In fact, Hammond's own text (1999) highlights that other health professionals can use and adapt EFN findings within their own assessment. This situation has gained even more evidence in the last decade with the dissemination of multiprofessional care, so that in current clinical practice it is possible that the EFN is executed together with other members of the health team, especially in hospital settings.

In this sense, throughout its theoretical evolution in the scientific literature, the EFN was adapted for use in several medical specialties: the Israeli Institute of Teaching and Research Albert Einstein, for example, published on February 4, 2020 the Brazilian Consensus on Nutrition in Hematopoietic Stem Cell Transplantation for Adults and, in it, states that the EFN is one of the “pillars of appropriate clinical diagnosis” reinforcing the importance of its application in this specialty.

Finally, it is worth clarifying that this same adaptability implies one of its main limitations: many of the clinical signs evidenced by the EFN are not exclusive indicators for pathologies or depletive conditions of nutritional status, on the contrary. It is common, for example, that changes in hair colour are due to dyeing or discolouration and not to hypovitaminosis.

In summary, although it requires specialized training and continuous practice of the evaluator and/or the team – in addition to requiring complementary nutritional information – the physical nutritional examination can still be considered an effective adjuvant method in the clinical evaluation of the patient's nutritional status.

4. Competing Interests

The authors declare no competing interests.

5. References

ASBRAN. FIDELIX, M. S. P. Guidance manual: systematisation of nutrition care. São Paulo: Asbran; 2014.

ASPEN. ESPER, Dema Halasa. Utilization of nutrition-focused physical assessment in identifying micronutrient deficiencies. *Nutrition in Clinical Practice*, v. 30, n. 2, p. 194-202, 2015.

BARBAN, Juliana Bernardo et al. Brazilian Consensus on Nutrition in Hematopoietic Stem Cell Transplantation: Adults. Einstein (São Paulo), v. 18, 2020.

CEDERHOLM, Tommy et al. GLIM criteria for the diagnosis of malnutrition—a consensus report from the global clinical nutrition community. *Journal of cachexia, sarcopenia and muscle*, v. 10, n. 1, p. 207-217, 2019.

DETSKY, Allan S. et al. What is subjective global assessment of nutritional status?. *Journal of parenteral and enteral nutrition*, v. 11, n. 1, p. 8-13, 1987.

HAMMOND, Kathy A. The nutritional dimension of physical assessment. *Nutrition (Burbank, Los Angeles County, Calif.)*, v. 15, n. 5, p. 411-419, 1999.

HAMMOND, KATHY. Nutrition-focused physical assessment. *Home Healthcare Nurse*, v. 17, n. 6, p. 354-355, 1999.

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/>).

Anti-inflammatory foods: human food patterns, bioactive principles and mechanisms of action

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.

Geanlucas Mendes Monteiro

Heath 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

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Vanessa de Souza Ferraz

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Jessica Alves Ribeiro

Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Dayane Aparecida Moisés Caetano Bottini

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Aline Ortega Soloaga

Federal University of Mato Grosso do Sul (UFMS).
Campo Grande-MS, Brazil.

Nelson Thiago Andrade Ferreira

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Tayla Borges Lino

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Flavia Soares Bezerra Okumoto Nery de Mello

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Juliana Vicente de Souza

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Fernanda Viana de Carvalho Moreto

MSc., Nutrition, Food and Health Graduate Program, Federal University of Grande Dourados

Abstract

With the increase in life expectancy accompanied by the gradual decrease in the birth rate as well as the greater income distribution associated with the quantitative increase in the minimum wage above inflation and the increase in its purchasing power, today the Brazilian population shows a moment exactly opposite to that found in the last century both in epidemiological terms and in the nutritional pattern. Brazil is currently experiencing the same pattern of mortality as developed countries: the majority of chronic non-communicable diseases are the main cause of death associated with an established model of obesity and sedentarism. These factors incline the scientific community and health professionals to turn their efforts to find food solutions that ease this epidemiological picture and it is in this context that anti-inflammatory foods have gained prominence. The following describes the main compounds that fit this magnitude of effect and their mechanisms of action.

Keywords: Anti-inflammatory foods; food patterns; human food.

1. Human food patterns and biological impact

With the advent of the industrial revolution, European society and, later, other continents, experienced a broad change not only in the mode of production – portrayed in a satirical and no less critical way in Charles Chaplin's "Modern Times" – but also experienced a transformation in the way we relate to time and, consequently, to our food.

The rural exodus, the emergence of megalopolis, the concentration of the labor force in isolated places in residential areas, and also the entry of women into the labor market has driven a growing demand for meals outside the home and not only this, but meals that fit into daily production.

In Brazil, the epidemiological portrait of the beginning of the last century to the middle of the 90's was made by a country whose great part of the deaths came from infectious diseases of etiology linked to social problems whose prophylaxis depended not only on a health service of immediate and individual action, but on political actions that demanded strong investments in several public sectors, among them basic sanitation and education.

Parallel to this, the nutritional pattern was composed of malnutrition at epidemic levels, a situation that was

further aggravated by analyzing more interior regions and regions of difficult geographic access, such as the northeastern sertão and certain Amazonian communities.

The recent economic advances that have driven Brazil to the position of developing country as well as the recent social and welfare achievements implemented in the country since the 1990s as well as its restructuring, institutionalization and normatization in the first decade of this century have provided the country with a profound change in the epidemiological and nutritional situation, a fact evidenced by the most recent data from population surveys that show a considerable increase in life expectancy, due to the improvement in the educational framework, drastic decrease in infant mortality and the incidence of malnutrition.

However, with the increase in life expectancy accompanied by the gradual decrease in the birth rate as well as the greater income distribution associated with the quantitative increase in the minimum wage above inflation and the increase in its purchasing power, today the Brazilian population shows a moment exactly opposite to that found in the last century both in epidemiological terms and in the nutritional pattern. Brazil is currently experiencing the same pattern of mortality as developed countries: the majority of chronic non-communicable diseases are the main cause of death associated with an established model of obesity and sedentarism.

2. Anti-inflammatory foods

These factors incline the scientific community and health professionals to turn their efforts to find food solutions that ease this epidemiological picture and it is in this context that anti-inflammatory foods have gained prominence. The following describes the main compounds that fit this magnitude of effect and their mechanisms of action.

Phytoalexins are compounds whose anti-inflammatory effect is well described in the scientific literature. Their main representative is resveratrol which can be found in its cis or trans form, the second being the most chemically stable and bioactive.

This compound inhibits the expression of pro-inflammatory cytokines in LPS-stimulated lung cells, suppresses activation of NF- κ B and AP-1 transcription factors, inhibits activation of JNK and its upstream protein MEK, and inhibits gene expression of COX-2 and iNOS enzymes and cell surface adhesion molecules ICAM-1, ELAM-1 and VCAM-1.

The main food source of resveratrol is *Vitis vinifera* and, consequently, the dry red wine; other grape varieties as well as derived products tend to present reduced amounts of this compound since its concentration in the fruit is largely related to the type of soil and climate of the planting region, which places Brazilian grapes as one of the varieties with the lowest concentration in resveratrol.

The presence of alcohol in the fermented beverage of *Vitis vinifera*, contrary to what you can imagine common sense, serves as a vehicle of absorption to this compound. However, one should be cautious and parsimony in the consumption since, nevertheless, alcoholism and its consequences are also one of the pathologies that cause most deaths in the world.

The latest studies estimate that 200mL of dry red wine daily presents significant reduction of inflammatory markers in the accumulation of 6 months in individuals with chronic non-communicable diseases and, on

the other hand, the cardioprotective benefit of this ingestion in the healthy population still remains an unknown.

Other two compounds that present known anti-inflammatory action are curcumin and catechins; the first is a phenolic pigment of yellowish tone that can be found in the plant *Curcuma longa* and in vitro tests have already indicated positive results for its antibacterial, antiviral, antifungal and even antitumoral action; already catechin is a flavonoid widely found in the plant *Camellia sinensis* from which the so popular green tea is made.

In common, these two compounds have the primary defense action in the plant and, again contrary to simplistic reasoning, are present in higher concentrations when originating from poor soils. This is due to the inversely proportional relationship between the bioavailability of soluble nitrogen contents in the soil and the concentration of defense compounds in the plant. The most common species in fertile soils tend to allocate carbon compounds for plant growth, thus decreasing the carbon/nutrient ratio, while plants from less fertile soils tend to drastically increase the synthesis of secondary defense compounds, becoming a more nutritionally attractive species at the biochemical level.

In in vitro studies curcumin has been shown to be able to modulate the expression of molecular targets including NF- κ B and consequently to modulate the transcription of COX-2, iNOS, VCAM-1, ICAM-1, TNF- α , IL-1, IL-6, IL-8, IL-12 and interferon- γ . In addition, it was able to sequester reactive oxygen species from TNF- κ B activation in the TNF- α -dependent step, as well as forbol-12-acetate-13-myristate (PMA) and hydrogen peroxide, and inhibited JNK activation in cells stimulated by TNF- α , ionizing radiation, PMA and UV-C.

Catechins in green tea inhibit the activation of the transcription factor NF- κ B while inhibiting the degradation of I κ B- α induced by cell activation mediated by TNF- α , decrease the activity of the IKK protein involved in the phosphorylation of I κ B- α and reduce both the gene expression of the enzyme COX-2 as well as the protein JNK and the transcription factor AP-1.

A typical raw extract of the rhizomes of the *Curcuma longa* plant contains about 70% to 76% curcumin, however there are no experimental or human studies predicting daily recommendations; studies in Asian populations – largest consumers of green tea in the world – have shown that the ingestion of 1.5Kg of *Camellia sinensis* leaf/year decreases the risk of prostate cancer by 99.91% and that regular daily consumption (min. 4x/week) is related to a lower prevalence of cognitive decline at advanced ages.

But perhaps, among the class of compounds whose anti-inflammatory action has already been described and substantiated by science, the most popular ones with the greatest diffusion in the media are the n-3 and n-6 polyunsaturated fatty acids: those commonly known as omega 3 and omega 6.

They are considered essential fatty acids, i.e., they are lipids that must be obtained by diet since the human body is not able to synthesize them naturally. This inability is due to the absence of the desaturase enzyme responsible for inserting a double bond between the C3-4 and C6-7 carbons in the terminal portion of the lipid chain; that is, although we physiologically produce the lipid precursors, our body is unable to convert them into omega-3 and omega-6, with a forced shutdown of the biochemical conversion chain in the lipid route.

There is no certain evolutionary explanation for this fact, but – in the field of anthropological hypotheses, perhaps it was this biological incapacity that “forced” the human species to seek greater variety in the basic

foods of its diet by increasing it with animal and vegetable proteins coming from the oceans, since today it is known that deepwater fish and algae are species endowed with the said enzyme absent in our body and, therefore, are the source of the fatty acids of the n-3 and n-6 family.

Speaking of source foods, the main representatives of omega 3 are the α -linolenic acid found mainly in seeds such as flaxseed and soya, and eicosapentaenoic acid whose main source is deepwater fish such as sardines, tuna and mackerel. Regarding omega 6, its main representatives are linoleic and arachidonic acids and, for both, the main food source are oilseeds and soy, corn and sunflower oils.

In the metabolic route of lipids in the human body the final biochemical compound of these fatty acids are called eicosanoids and they are responsible for the anti-inflammatory action. What is very little disclosed is the fact that not all eicosanoids will have action favorable to health, quite the contrary! In fact, omega-6-derived eicosanoids can, in fact, give rise to by-products – such as prostaglandins, leukotrienes, prostacyclins and thromboxanes – which are responsible for triggering and worsening the individual's inflammatory condition. Everything will depend on a key factor: the proportion existing between omega 3 and omega 6 in the diet.

This is due to the fact that there is a very specific pre-established concentration of the enzymes responsible for the process of conversion of these fatty acids in the human being and, depending on the ratio of them in the diet, the inflammatory route may be overactivated to the detriment of the synthesis of anti-inflammatory eicosanoids.

In biochemical terms, the adequate ratio recommended in the diet is in the range from 5:1 to a maximum of 10:1; that is, the limit for obtaining the beneficial effects of these fatty acids in the diet is the presence of 10 units of omega 6 for every 1 unit of omega 3. However, since soy oil is a source food of the n-6 family and is culturally consumed in excess by many individuals, studies indicate that the world average reaches values between 20:1 and alarming 32:1 in western populations, more than 3x plus the maximum recommended proportion.

From this comes the danger of supplementation in capsules of these fatty acids. Besides the fact that in our country, the legislation pertinent to the trade of these supplements is still in the process of consolidation, which opens dangerous market gaps for the sale of adulterated products, we can add the fact of the high consumption of soy oil; these factors contribute to an exacerbated consumption of omega 6 to the detriment of omega 3 which, as seen, will bring harmful effects instead of that desired by the individuals who consume them.

In fact, not only in relation to essential fatty acids, but also in relation to the other anti-inflammatory compounds described in this text, scientific nutritional studies indicate that considering bioavailability, absorption and effectiveness, the best way to consume these compounds is still the most natural possible: the food itself! The anti-inflammatory efficacy of omegas 3 and 6 present in fish such as sardines is almost 4x higher compared to the efficacy of the same compounds when ingested in food supplement capsules available on the market.

3. Competing Interests

The authors declare no competing interests.

4. References

- Broughton KS, Wade JW. Total fat and (n-3):(n-6) Fat ratios influence eicosanoid production in mice. *J Nutr* 2002;32:88-94.
- Garg ML, Thomson ABR, Claudinin MT. Interactions of saturated, n-6 and n-3 polyunsaturated fatty acids to modulate arachidonic acid metabolism. *J Lipid Res* 1990;31:271-7.
- Holst B, Williamson G. Nutrients and phytochemicals: from bioavailability to bioefficacy beyond antioxidants. *Curr Opin Biotechnol*. 2008;19(2):73-82.
- Konig D, Berg AC, Weinstock C, Keul J, Northoff H. Essential Fatty Acids, Immune Function and Exercise. *Exerc Immunol Rev*, 1997;3:1-31.
- Larsen CS. Animal source foods and human health during evolution. *J Nutr*. 2003;133(11 Suppl 2):3893S-7S.
- Martins CA, Almeida, VV, Ruiz MR, Visentainer JEL, Matshushita M, Souza, NE, et al. Omega-3 and omega-6 polyunsaturated fatty acids: importance and occurrence in food. *Rev Nutr*. 2006.
- Minich DM, Bland JS. Dietary management of the metabolic syndrome beyond macronutrients. *Nutr Rev*. 2008;66(8):429-44.
- Nestle M. Animal v. plant foods in human diets and health: is the historical record unequivocal? *Proc Nutr Soc*. 1999;58(2):211-8.
- Parker CW. Leukotrienes and Prostaglandins in the Immune System. *Adv Prost Trom Leukot Res* 1986;16:113-34.
- Sabate J. The contribution of vegetarian diets to health and disease: a paradigm shift? *Am J Clin Nutr*. 2003;78(3 Suppl):502S-7S.
- Wallace FA, Miles EA, Calder PC. Comparison of the effects of linseed oil and different doses of fish oil on mononuclear cell function in healthy human subjects. *Br J Nutr* 2003;89(5):679-89.
- Wanten GJ, Calder PC. Immune modulation by parenteral lipid emulsions. *Am J Clin Nutr*. 2007; 85(5):1171-84.
- Williamson G, Holst B. Dietary reference intake (DRI) value for dietary polyphenols: are we heading in the right direction? *Br J Nutr*. 2008;99 Suppl 3:S55-8.

Youdim KA, Martin A, Joseph JA. Essential fatty acids and the brain: possible health implications. *Int J Dev Neurosci*. 2000; 18(4/5):383-99.

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/>).

Endocannabinoid system: conceptual parameters, history and therapeutic possibilities

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.

Geanlucas Mendes Monteiro

Heath 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

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Vanessa de Souza Ferraz

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Flavia Soares Bezerra Okumoto Nery de Mello

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Dayane Aparecida Moisés Caetano Bottini

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Nelson Thiago Andrade Ferreira

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Tayla Borges Lino

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Juliana Vicente de Souza

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Gildiney Penaves de Alencar

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

Wesley Sebastião da Silva Moraes

Exercise Physiology and Sports Training Graduate Program, Alfredo Torres Institute of Education and Research.
Campo Grande, Mato Grosso do Sul – Brazil.

Fernanda Viana de Carvalho Moreto

MSc., Nutrition, Food and Health Graduate Program, Federal University of Grande Dourados

Abstract

Among the drugs considered illicit in the West, the Cannabis sativa plant is the most consumed: around 4% of the adult population, 10% of these users are in a situation of dependence. However, the medicinal use of this herb dates back to the early days of the emergence of our own species: some anthropologists theorize that some of the genus Homo has progressed in the struggle for survival with other hominids precisely because of the advanced knowledge – kept to the proper proportions – it possessed of plants like Cannabis. Millennia later, science – even focusing intensely on the chemical characterization of its more than 530 bioactive components – was still not able to generate verifiable hypotheses in order to explain two of the most remarkable characteristics of the recreational use of this plant: because small chemical changes potentiated the effect of the drug up to 100 times and, mainly, because it would be virtually impossible for an individual to suffer a lethal overdose of the substance. To overcome this paradigm, some compounds derived from delta-ninetetrahydrocannabinol (Δ^9 -THC) - the main component of cannabis – were radioactively marked in an experimental study and, after their induction, it was discovered that they had tropism by brain membranes and that their binding was saturated and stereosleptic. Such evidence strongly suggested the existence of endogenous receptors for the drug and it was these findings that led to the discovery of the Endocannabinoid System (SEC): a physiological apparatus made up of endogenous receptors and binders, philogenetically conserved, responsible for several controls related to neuronal homeostasis.

Keywords: *Cannabis sativa*; Endocannabinoid system; Therapeutic possibilities.

1. Introduction

Among the drugs considered illicit in the West, the *Cannabis sativa* plant is the most consumed: around 4% of the adult population, 10% of these users are in a situation of dependence. However, the medicinal use of this herb dates back to the early days of the emergence of our own species: some anthropologists theorize that some of the genus Homo has progressed in the struggle for survival with other hominids precisely

because of the advanced knowledge – kept to the proper proportions – it possessed of plants like *Cannabis*. Millennia later, science – even focusing intensely on the chemical characterization of its more than 530 bioactive components – was still not able to generate verifiable hypotheses in order to explain two of the most remarkable characteristics of the recreational use of this plant: because small chemical changes potentiated the effect of the drug up to 100 times and, mainly, because it would be virtually impossible for an individual to suffer a lethal overdose of the substance.

To overcome this paradigm, some compounds derived from delta-ninetetrahydrocannabinol (Δ^9 -THC) – the main component of cannabis – were radioactively marked in an experimental study and, after their induction, it was discovered that they had tropism by brain membranes and that their binding was saturated and stereosleptic. Such evidence strongly suggested the existence of endogenous receptors for the drug and it was these findings that led to the discovery of the Endocannabinoid System (SEC): a physiological apparatus made up of endogenous receptors and binders, philogenetically conserved, responsible for several controls related to neuronal homeostasis.

The receptors, according to the order of discovery, were classified into CB1 and CB2: while the former is responsible for most of the psychotropic effects – besides being the most abundant in the Central Nervous System (CNS) – the CB2 receptors have their majority expression in the immune system, in the microglia and in pathological conditions such as chronic pain. Their density is described in Table 1.

Table 1 - Density of CB1 and CB2 receptors.

DENSITY	RECEPTOR	
	CB1	CB2
Top	Olfactory bulb, hippocampus, lateral striated, striated nuclei and cerebellum	Cells of the immune system
Moderated	Prosencephalus, frontal lobe, parietal and cincture, septum, amygdala, ventromedial hypothalamus, lateral subclair of the interpeduncular nucleus, parabrachial nucleus, solitary tract nucleus and dorsal medulla horn	-
Download	Thalamus, medulla ventral horn and other brain stem nuclei	Microglia

2. Mechanisms of action

The mechanism of action of both are similar and culminate in neuronal hyperpolarization causing a decrease in the release of neurotransmitters in the synaptic cleft: CB1, when active, inhibits adenylcyclase which, in turn, leads to a deficit in the conversion of ATP into cAMP by decreasing the action of kinase A (PKA); with the reduction of phosphorylation of potassium channels – generating the output of these ions in presynaptic cells – inhibition of voltage-sensitive calcium channels occurs, leading to neuronal desensitization.

On the other hand, CB2 – which presents a 44% homologous physical-chemical structure to CB1 receptors – has inhibitory activity of Gi proteins which, in turn, inhibit adenylcyclase, thus activating the MAPK

protein cascade. Due to these characteristics the SEC constitutes one of the exceptions to the law of dynamic polarization postulated by Ramon and Cajal in 1891 since they follow the retrograde direction of synaptic transmission.

Shortly after the characterization of these receptors, science dedicated itself to the study of endogenous binders for the SEC of which two are the most quantitatively relevant: anandamide (N-araquidonylethanolamide) - Sanskrit terminology for “eternal happiness” - and 2-araquidonilglycerol (2-AG). While the latter presents high selectivity for CB1/CB2 receptors performing total agonist action for them, anandamide is only partial agonist for CB1/CB2 presenting still low affinity for TRPV1.

The synthesis of these binders occurs by means of noncontinuous membrane phospholipid precursors, i.e., they are produced on demand in postsynaptic neurons without prior vesicular storage with direct release into the synaptic cleft or via the bloodstream. Although there is considerable redundancy in this process, the mediation and regulation of the synthesis is done by the accumulation of calcium ions in the postsynaptic neuron being this the limiting step.

For the production of anandamide, N-acyltransferase (NAT) is activated by converting phosphatidylethanolamine and phosphatidylcholine into N-araquidonylphosphatidylethanolamine (NAPE), leading to hydrolysis of NAPE by N-araquidonylphosphatidyl-ethanolamine-phospholipase-D (NAPE-FLD), generating anandamide; already in the case of 2-AG, the main route is that of phospholipase-C-beta-diacylglycerol-lipase: FLC β converts membrane phosphoinositide into 1,2-diacylglycerol which, when hydrolysed by DAGL, forms the endocannabinoid.

3. Therapeutic possibilities

One of the actions described by the SEC, however, is its relationship with the pleasure circuit. In the classical view abuse drugs trigger this circuit by means of second order dopamine neurons in the ATV-NAc axis either by direct action on the dopamine terminals or indirectly under the modulatory inputs; today, however, it is accepted that endocannabinoids contribute to the motivational homeostasis by defining a setpoint acting on the control inputs of the pathway leading to an inversely proportional relationship: The SEC acts maintaining the motivational homeostasis while the exogenous cannabinoids lead to the disturbance of the pathway by neuromodulatory destructuring and alteration of the setpoint of the circuit leading the individual to the behavior called drug seeking & drug taken.

Moreover, the completion of the SEC in sites relevant to memory and its action in modulating it becomes relevant with regard to the promotion and construction of the kidnapping of GABA in order to make it difficult to solidify aversive memories. The interference performed in this process by Δ 9-THC, with LTD blocking and consequent translocation of the setpoint for extinction of aversive memories, may significantly alter the impact of memories related to the reward system.

Moreover, in recent years new models have been postulated regarding this system so that there is suspicion, with a reasonable degree of legitimacy, of the existence of at least one more endogenous cannabinoid receptor called until then “putative receptor type CB3” besides the characterization of more binders still little described. The hypothesis that unassociated factors are triggers of mechanisms integral to the ESA is also hypothesized: it is described, for example, that certain membrane disorders are capable of activating

the cascade of pre-synaptic hyperpolarization reaction in an effect equivalent to receptors of type CB1 and CB2.

In this way, the SEC has a general modulatory effect in decisive ways, as seen, in the phenomena related to drug abuse disorders since it collaborates to the establishment of setpoints in multiple neuronal processes; drugs with the modulatory activity of the SEC, therefore, may compose in the coming years a therapeutic focus in the prophylaxis of disorders related to a wide spectrum of neuronal pathologies, from the drug abuse disorder itself to even Alzheimer's.

4. Competing Interests

The authors declare no competing interests.

5. References

Ameri A. The effects of cannabinoids on the brain. *Prog Neurobiol.* 1999;58(4):315-48.

Bonfa L, Vinagre RC, de Figueiredo NV. Cannabinoids in chronic pain and palliative care. *Rev Bras Anesthesiol*, 2008;58(3):267-79. English, Portuguese.

Cooper ZD, Haney M. Cannabis reinforcement and dependence: role of the cannabinoid CB1 receptor. *Addict Biol.* 2008;13(2):188-95.

Dennis M, Babor TF, Roebuck MC, Donaldson J. Changing the focus: the case for recognizing and treating Cannabis use disorders. *Addiction.* 2002;97(Suppl 1):4-15.

Di Marzo V, Bisogno T, De Petrocellis L. Endocannabinoids: new targets for drug development. *Curr Pharm Des.* 2000;6(13):1361-80.

Fattore L, Fadda P, Spano MS, Pistis M, Fratta W. Neurobiological mechanisms of cannabinoid addiction. *Mol Cell Endocrinol.* 2008;286(1-2 Suppl 1):S97-107.

Hazekamp A. Medicinal use of Cannabis: a review. Leiden, The Netherlands: Leiden University, Department of Plant Metabolomics; 2008.

Pacher P, Bátkai S, Kunos G. The endocannabinoid system as an emerging target of pharmacotherapy. *Pharmacol Rev.* 2006;58(3):389-462.

Vandrey R, Haney M. Pharmacotherapy for Cannabis dependence: how close are we? *CNS Drugs.* 2009;23(7):543-53.

Zuardi AW. History of Cannabis as a medicine: a review. *Rev Bras Psiquiatr.* 2006; 28(2):153-7.

Energy metabolism: gluconeogenesis and oxidative phosphorylation

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.

Leandro Rachel Arguello

Dom Bosco Catholic University
Campo Grande, Mato Grosso do Sul – Brazil.

Nelson Thiago Andrade Ferreira

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, 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.

Jessica Alves Ribeiro

Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Juliana Vicente de Souza

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Sarita Baltuilhe dos Santos

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
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.

Ygor Thiago Cerqueira de Paula

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Vanessa de Souza Ferraz

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Tayla Borges Lino

Motion Science Graduate Program, Federal University of Mato Grosso do Sul
Campo Grande, Mato Grosso do Sul – Brazil.

Thiago Teixeira Pereira

Health Sciences Graduate Program, Federal University of Grande Dourados

Abstract

Most animal cells are able to meet their energy needs from the oxidation of various types of compounds: sugars, fatty acids, amino acids, but some tissues and cells of our body depend exclusively on glucose and the brain is the largest consumer of all. That is why the body has mechanisms in order to keep glucose levels stable. As it decreases, the degradation of hepatic glycogen occurs, which maintains the appropriate levels of blood glucose allowing its capture continues by those tissues, even in times of absence of food intake. But this reserve is limited, so another metabolic pathway is triggered for glucose production, which occurs in the kidneys and liver and is called gluconeogenesis, which means the synthesis of glucose from non-glucose compounds such as amino acids, lactate, and glycerol. Most stages of glycolysis use the same enzymes as glycolysis, but it makes the opposite sense and differs in three stages or also called deviations: the first is the conversion of pyruvate to oxaloacetate and oxaloacetate to phosphoenolpyruvate. The second deviation is the conversion of fructose 1,6 biphosphate to fructose 6 phosphate and the third and last deviation is the conversion of glucose 6 phosphate to glucose.

Keywords: Gluconeogenesis; Oxidative phosphorylation; Metabolism.

1. Introduction

Most animal cells are able to meet their energy needs from the oxidation of various types of compounds: sugars, fatty acids, amino acids, but some tissues and cells of our body depend exclusively on glucose and the brain is the largest consumer of all. That is why the body has mechanisms in order to keep glucose levels stable. As it decreases, the degradation of hepatic glycogen occurs, which maintains the appropriate levels of blood glucose allowing its capture continues by those tissues, even in times of absence of food intake. But this reserve is limited, so another metabolic pathway is triggered for glucose production, which occurs in the kidneys and liver and is called gluconeogenesis, which means the synthesis of glucose from non-glucose compounds such as amino acids, lactate, and glycerol.

Most stages of glycolysis use the same enzymes as glycolysis, but it makes the opposite sense and differs in three stages or also called deviations: the first is the conversion of pyruvate to oxaloacetate and oxaloacetate to phosphoenolpyruvate. The second deviation is the conversion of fructose 1,6 biphosphate

to fructose 6 phosphate and the third and last deviation is the conversion of glucose 6 phosphate to glucose. The control of gluconeogenesis is done by the glucagon it stimulates and the insulin it inhibits. Glycolysis and gluconeogenesis are regulated reciprocally by allosterism and covalent modifications to prevent unproductive two-way operation at the same time.

Oxidative phosphorylation is the final stage of the respiratory chain and is the phase in which most energy is produced. It is the main source of ATP in heterotrophic organisms under aerobic conditions. All the oxidative stages of degradation converge to this stage in which the energy from oxidation makes the synthesis of ATP.

Phosphorylation occurs in mitochondrial ridges and in the membrane of these ridges has several complexes that involve the reduction of O₂ in H₂O with electrons coming from NADH and FADH₂ and forming a chemotic gradient for the production of ATP. There are four complexes associated with different prosthetic groups and also two mobile components that make the transfer of electrons.

ATP feels that it can be called complex V, it catalyzes ATP synthesis through the energy of the proton gradient.

2. Gluconeogenesis

Gluconeogenesis is the liquid synthesis or formation of glucose from substrates other than carbohydrates, it is also called gluconeogenesis. Several amino acids, lactate, pyruvate, propionate and glycerol are sources of carbon for this route. It is important to point out that glucose can be produced from fructose, carbohydrate. The use of glycogen for glucose 6-phosphate synthesis must be distinguished from glycogenesis and is called glycogenolysis. Glucogenolysis refers to the breakdown of glycogen into glucose, and therefore does not correspond to the synthesis of new glucose.

Gluconeogenesis is important at stable levels. For blood glucose levels must be maintained to support the metabolism of tissues that use it as a primary substrate; such as the brain, erythrocytes, kidney, crystal, cornea, and testicles. Gluconeogenesis thus allows blood glucose levels to be maintained long after all the glucose in the diet has been absorbed and completely oxidized, and all the glucose stored as glycogen has been used.

Most neoglycogenesis is developed by the liver under fasting conditions, in which there is no more enough glycogen for glucose lysis (glycolysis). The other organ responsible for glucose synthesis by anglican compounds is the renal cortex.

It is important to remember that glycolysis becomes irreversible, i.e. it prevents your final substrates from being able to follow the paths for the conversion of new glucose. In living beings, this irreversibility occurs in three ways (all using heat released by the carbohydrate energy consumption) and are: the conversion of glucose into glucose 6-phosphate by hexokinase, the phosphorylation of fructose 6-phosphate into fructose 1,6-bisphosphate by phosphofructokinase and the conversion of phosphoenolpyruvate into pyruvate by pyruvate kinase. Thus, neoglycogenesis works with the aid of enzymes that work in other ways.

Several enzymes are used as catalysts, helping to transform substrates of glycolytic metabolism into new glucose. Most of the reactions that synthesize glucose in vivo act with its enzymes inversely to glycolysis, for example, pyruvate carboxylase and phosphoenolpyruvate carboxykinase.

Inside the gluconeogenesis there are two cycles involved between tissues, usually the hepatic glucose synthesis that releases it to peripheral tissues.

They are the cycles: of Cori, also called glycose-lactate cycle, and the cycle of alanine, or glycose-alanine cycle. Both are suppliers of glucose, continuously supplying the tissues that need it as their main energy source. Therefore, it is essential that peripheral tissues supply lactate and alanine as metabolites for energy extraction from glucose.

Also known as the glycose-lactato-glucose route, it uses the lactate produced in the muscles, during the deprivation of oxygen from this tissue, as a substrate for the conversion of glucose.

Intense muscle activity uses the reserved glycogen in the tissue as a source of energy via muscle glycolysis. From muscle glycolysis, glucose provides energy in the form of ATP converting into pyruvate. When the molecular oxygen supply is sufficient for pyruvate oxidation, the product is the release of water and CO₂. However, during intense physical activity, the distribution of oxygen to muscle tissue can easily become scarce and there is an independent need for energy (ATP) of oxygen. Thus, the pyruvate to be reduced, uses the catalysis of the enzyme pyruvate dehydrogenase, favoring the formation of lactate. This lactate accumulates in muscle tissue in the form of lactic acid and spreads through the bloodstream to the liver, where it is metabolized into glucose.

An important factor about the conversion of lactate from lactic acid to glucose is that the conversion itself uses the energy of adenosine triphosphate, i.e., oxygen is involved in the oxidative phosphorylation process of ADP into ATP. This is an important factor, since it explains the accelerated respiration after intense physical activity, capturing oxygen for the transformation of lactate into glucose, and then back into glycogen in the muscles, thus via glycose-lactato-glucose.

With the exception of leucine and lysine, all amino acids can provide carbon for glucose synthesis when catabolized in pyruvate and oxaloacetate.

2-Aminopropanoic acid, commonly called alanine, is one of the simplest amino acids as it does not contain benzene rings. It varies from other amino acids by its methyl group bound to carbon α , thus presenting hydrophobic character.

Pyruvic acid is the final product of the glycolysis reaction, and in aqueous medium it dissociates into pyruvate, important in metabolic processes. When an amine group binds to pyruvate, in living beings, the synthesis of alanine occurs.

The pyruvate is easily converted to oxaloacetate by the enzyme pyruvate carboxylase, a catalyst that in the gluconeogenesis inverts the flow of carbon.

Another possible way for the organism to supply the energetic demand for glucose in its absence is through the lipidic route, in which fatty acids will be converted into glucose depending on a series of factors limiting the reactions that make up this metabolic process.

The first of these limiting factors is due to the fact that most of the fatty acids available in the body are composed of an even number of carbons; in this case their oxidative catabolism will give rise to acetyl CoA which, in turn, may either generate ketonic compounds or follow the path of the citric acid cycle. In both cases, the gluconeogenesis does not form intermediates when its occurrence is impeded.

Fatty acids consisting of an odd number of carbons, however, or which have in their branch a methyl grouping are metabolized in a strong intermediate of gluconeogenesis: the propionyl CoA which can be

converted into oxaloacetate producing, at the end of the cycle, $\frac{1}{2}$ glucose molecule.

It is often said, erroneously in a generic way, that "fat" does not enter the gluconeogenesis pathway; however, it is not taken into account in this statement that a good part of the fat present in the organism is stored in the fat tissue in the form of triacylglycerol and that its metabolism produces another absolute intermediary of this pathway: the glycerol itself.

The glycerol generated in the lysis of the fat molecule of fat tissue by the action of glycerol kinase is phosphorylated in glycerol 3-phosphate which, in turn, is dehydrogenated by glycerol 3-phosphate dehydrogenase in dihydroxyacetone phosphate which, depending on the nutritional status of the individual, may be converted into lactate and followed by gluconeogenesis or cleaved into pyruvate following the oxidative route to CO₂ and H₂O.

The control of gluconeogenesis can be done by three mechanisms: negative feed back (the products of the reaction inhibiting its start automatically), by allosteric inhibition (programmed inhibitors inactivating the enzymes involved in the process), and by hormonal regulation, the latter being the focus of this work.

The two hormones involved in the regulation of this route are insulin and glucagon. Both produced by the endocrine portion of the pancreas in the beta and alpha pancreatic cells (respectively), are opposite of the energy metabolism pathway being the first catabolic and the second anabolic in the second stanza since it primarily stimulates glycogenolysis.

When the organism is in regular situations in terms of glycemic rate both compete with each other on their actions being secreted in minimum portions. Once this rate is at high levels (indicated high dietary intake) the pancreas is stimulated by a series of chemical, physical and hormonal factors and secreting the insulin which will be responsible for displacing the metabolism for glycolysis by activating the membrane carriers GLUT 4 to capture to the cytosol the glucose available in the bloodstream.

Otherwise – low glycemic rate – these same factors stimulate the pancreas to secrete glucagon. This will be responsible for sequencing the start of glycogenolysis by shifting the energy metabolism to the consumption of the glycogen stored in the liver and muscles; once this muscle and visceral stock is depleted and there is still glycidic demand, it remains circulating in the bloodstream stimulating the gluconeogenesis from the triacylglycerols stored in the subcutaneous fat tissue. In the last case – individuals with very severe malnutrition – proteolysis can still occur stimulating glycidic neosynthesis from amino acids such as alanine by the Cori cycle.

Excessive alcohol consumption, especially by undernourished people, can cause hypoglycemia. Hypoglycemia is an inhibitory effect of alcohol on hepatic gluconeogenesis, the liver is unable to cope with the reduction equivalents formed by the oxidation of ethanol, and a metabolic disorder occurs. These equivalents, instead of converting lactate to glucose, convert from alanine to lactate, with excessive accumulation of lactate in the blood, and lactic acidosis can develop, although it is usually mild.

Alcohol consumption can lead to a loss of motor and intellectual performance, stupor and anesthesia. Hypoglycemia also contributes to these effects, i.e. the person is really drunk when their blood sugar is low and can lead to irreversible damage to the central nervous system.

• GLUCOSE

Glucose is the largest substrate for brain metabolism and the brain is the primary organ in the use of glucose, with brain size being the main determinant of glucose production.

- **HIPOGLICEMIA:**

Plasma glucose is less than 40 mg% (plasma glucose is approximately 10%-15% higher than blood).

Premature newborns of gestational age are more susceptible to hypoglycemia than children born full-term or of the right size for their age. Children in general are also quite susceptible than adults simply because they have a higher brain/body weight ratio and the brain uses disproportionately higher amounts of glucose than the rest of the body. Newborns have limited ketogenic capacity, apparently because the transport of long chain fatty acids into hepatic mitochondria is underdeveloped. Because the use of ketone bodies by the brain is directly proportional to the concentration of circulating ketone bodies, the newborn is unable to save glucose in significant amounts by using ketone bodies. Thus, the neonate brain depends exclusively on glucose from glycogenolysis and gluconeogenesis.

The liver's ability to synthesize glucose from lactate and alanine is also limited in newborn children because the speed limiting enzyme, phosphoenol pyruvate carboxyl kinase, is present in very small amounts during the first few hours after birth. Its induction at the necessary level to avoid hypoglycemia during fasting stress takes a few hours. Premature and young children for gestational age also have lower glycogen reserves more quickly, making them glycogen-dependent than normal children.

In a more simple way, it would be like saying that the lower the glucose value, the brain becomes deficient, since the brain does not stock glucose and particularly the very low weight RNs have low substrates to maintain the glucose concentration. As glucose falls, there is an increase in fatty acids, and free radicals, with a decrease in the energy substrate for the brain. In hypoglycemia, the transport of ions is impaired and activates the mechanisms of loss of cell membrane integrity, allowing the entry of calcium and sodium into the cell, leading to cell swelling and neuronal death.

3. Therapeutic possibilities

Oxidative phosphorylation is the final stage of energy producing metabolism in aerobic organisms. All oxidative steps in the degradation of carbohydrates, fats and amino acids converge to this final stage of cellular respiration in which the energy from oxidation is responsible for ATP synthesis.

In a simplified way oxidative phosphorylation provides ATP to the cells from the glycolysis co-factors, Krebs cycle and acetyl-CoA converted nutrients that follow the citric acid cycle.

Unlike the Krebs cycle that occurs in the mitochondrial matrix, the respiratory chain or electron transport chain, occurs in the mitochondrial matrix in prokaryotic cells.

In the presence of oxygen, hydrogen electrons released from NADH and FADH₂ pass through a cascade system by enzymatic complexes in the membrane of mitochondria and cytochromes, which transport these electrons between one complex and another.

This passage of energy through mitochondrial membrane enzymes is important because it accepts hydrogen electrons, decreasing its energy until it transports them to the oxygen atom forming water. If there were not a transport that would decrease the energy of the hydrogen electrons, all the contained energy would be dissipated in the form of heat, which is not advantageous for the organism. So, there is a system that transports electrons and pumps protons against the membrane electric gradient using this energy for ATP (the cellular chemical energy) synthesis.

(a) Complex I

The first hydrogen electron-accepting enzyme is called NADH-ubiquinone oxido-reductase or simply Complex I. This complex transfers the electrons that were previously carried by NADH to Cytochrome. This enzyme has a component called FMN (flavine mononucleotide), which similar to FAD is capable of receiving 2 protons and 2 electrons. The FMN has a partially reduced form (when it receives 1 proton and 1 electron) called semiquinone or FMNH. The FMNH has a free radical that accepts 1 more proton and 1 electron becoming FMNH₂, its totally reduced form.

In addition to the FMN, Complex I has iron-sulfur centers (Fe-S) that are not proton acceptors and carry only electrons, received or donated by the Fe ion, whose valence alternates between Fe³⁺ and Fe²⁺. The Fe-S centers are still present in Complexes II and III. The S portion of this protein is bound to cysteine residues.

The FMN portion of this enzyme receives the hydrogen from NADH oxidizing it to NAD and reducing to FMNH₂. It is important to note that the reduction of FMN implies the removal of a proton from the mitochondrial matrix. The electrons of the FMNH₂ formed go to the Fe-S centers until the Coenzyme Q, leaving the Complex I. The protons, as they are not accepted by the iron-sulfur centers, are pumped to the space between the mitochondrial membranes.

(b) Complex II

The complex II also called succinate dehydrogenase or succinateubiquinone oxido-reductase makes up the electron chain in addition to participating in the Krebs cycle, oxidizing the succinate to fumarate.

One of the differences of complex I is the electron acceptor component of the enzyme, using FAD. FAD oxidizes the succinate producing fumarate and FADH₂. When NADH₂ donates its electrons to the Fe³⁺ ion of the Fe-S centers, protons of H are discarded back into the mitochondrial matrix. It is also possible to notice that different from complex I, the energy from the transfer of electrons to the coenzyme Q is not enough to pump protons against the concentration gradient.

(c) Coenzyme Q

Between the path that the electrons travel through the complexes, before reaching the complex III, there is after the complexes I and II the coenzyme Q.

Coenzyme Q functions as a convergence point of NADH from complex I, complex II succinate and other substrates that can be oxidized by donating their electrons through the respiratory chain reducing FAD to FADH₂. An example are the products of triacylglycerol metabolism. The electrons from these substrates pass directly from FAD to CoQ.

(d) Complex III

Complex III, ubiquinone-cytochrome c oxido-reductase or cytochrome bc₁ transfer electrons from ubiquinone to cytochrome c, accompanied by movement of protons. This enzyme is formed cytochrome b_L and b_H, cytochrome c₁ and a Fe-S protein.

According to the Q cycle, the III complex presents two distinct catalytic sites: one for oxidation of QH₂ being part of cytochrome b_L and the other for reduction of Q containing cytochrome b_H. With the oxidation

of QH₂, two protons are thrown in the intermembranous space and when Q is reduced, the protons are removed from the matrix.

Complex III by oxidizing coenzyme Q and reducing cytochrome c, removes two protons from the matrix and pumps four protons outside the mitochondria.

(e) Complex IV

Or cytochrome oxidase, carries two electrons from cytochrome c to molecular oxygen, reducing it to H₂O. The IV complex is a large protein of the internal mitochondrial membrane. It is divided into two subunits: Subunit I: Contains two heme groups designated a and a₃ and one copper ion (CuB). The heme a₃ and CuB form a second binuclear center that accepts electrons from the heme a and then transfers them to the O₂ connected to the a₃.

Subunit II: Contains two copper ions complexed with the -SH groups of two cysteine residues in a binuclear center that resemble the proteins of the 2F and 2S centers.

The transfer of electrons through the IV complex occurs from the cytochrome c to the CuA, from the heme a₃- CuB center and finally to the O₂. For each four H⁺ substrates of the matrix converting the O₂ into 2H₂O. The intermediates remain strongly bound to the complex until they are completely converted to water.

In summary the whole process is: NADH Ubiquinone Cytochrome b Cytochrome c₁ Cytochrome a₃ O₂ + 4 hydrogen ions = 2H₂O

The translocation of protons through the mitochondrial membrane is done by the complexes I, III and IV. According to Mitchell's 1961 hypothesis, electron transport energy is used to pump protons through the mitochondrial membrane. The consequence of pumping these particles is a difference in potential between the two sides of the membrane, the energy of this gradient is called proton-motor force, composed of two gradients: the pH gradient, derived from the accumulation of H in the space between membranes; and the electrical gradient, because the mitochondrial matrix becomes very electronegative when compared to the intermembranous space.

As the membrane is impermeable to protons, there are active sites that allow the spontaneous passage of protons. The same sites that allow this passage are constituted by the ATP synthesizer complex. ATP synthase catalyzes the formation of ATP when protons pass through the enzyme towards the interior of the mitochondria.

There are two hypotheses that try to explain proton pumping. One model, that of direct coupling, is used to justify the transport of protons through membranes by the Complexes I and III, proposing that the electron transporters, when reduced, capture protons from the mitochondrial matrix, and when transferred to the next component of the chain, release protons in the intermembrane space. This same hypothesis does not seem to be correctly applied to Complex VI, since this enzyme does not have components that present protons in the reduced state.

The other model, the indirect coupling, says the pumping of protons is distinct and not directly related to the transport of electrons. It proposes that the passage of energy promotes a different conformational change in oxidized and reduced states. Thus, changes related to the Bohr effect, after the transfer of electrons, cause a decrease in pK_a values, and the side chains are exposed on the outside of the membrane, releasing protons

into the intermembranous space.

The ATP synthase enzyme is formed from an invagination of the internal face of the mitochondrial internal membrane; this membranous portion is made up of microspheres attached to the membrane by stems that allow rotation on their own axis. Studies have shown that the treatment of mitochondria in ultrasound ends up producing fragments of this membrane that form spontaneous vesicles containing the microspheres attached by the stems on the external side of the membrane.

It is also noted that the vesicle devoid of its microspheres perform the function of electron transport and that the uncoupled microspheres of the complex end up promoting ATP hydrolysis. Based on these observations, it is inferred that ATP synthase has two distinct segments, F₀ for proton pumping and F₁ for ATP synthesis.

The F₀ portion is composed of six conjugations of interposed alphas and betas subunits and it is understood that the ADP + P_i = ATP reaction occurs due to a distinct structural conformation, momentary and sequential between the three beta subunits and as there is a transfer of energy from the process is used for the rotation of the enzyme transforming it from electrochemistry to mechanics saving the balance of ATPs produced is still one of the mysteries of biochemistry.

4. Competing Interests

The authors declare no competing interests.

5. References

DEVLIN, T. M. Manual of Biochemistry with Clinical Correlations. America: Edgard Blucher Ltda, 1998.

EXTON, J.H. Gluconeogenesis. Metabolism, v. 21, n. 10, p. 945-990, 1972.

HATTING, Maximilian et al. Insulin regulation of gluconeogenesis. Annals of the New York Academy of Sciences, v. 1411, n. 1, p. 21, 2018.

HEMS, R. et al. Gluconeogenesis in the perfused rat liver. Biochemical Journal, v. 101, n. 2, p. 284-292, 1966.

MADIRAJU, Anila K. et al. Metformin inhibits gluconeogenesis via the redox-dependent mechanism in vivo. Nature medicine, v. 24, n. 9, p. 1384-1394, 2018.

MARZZOCO, A.; TORRES, B. B. Basic biochemistry. Rio de Janeiro: Guanabara Koogan, 2007.

NELSON, D. L.; COX, M. M. Lehninger's principles of biochemistry. São Paulo: Sarvier, 2002.

PERRY, Rachel J. et al. Glucagon stimulates gluconeogenesis by INSP3R1-mediated hepatic lipolysis. Nature, v. 579, n. 7798, p. 279-283, 2020.

YAN, Hui et al. Estrogen improves insulin sensitivity and suppresses gluconeogenesis via the transcription factor Foxo1. *Diabetes*, v. 68, n. 2, p. 291-304, 2019.

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/>).

Family farming and sustainable rural development: a case study in a settlement in the Brazilian Amazon

Carlos Alberto Paraguassu-Chaves¹, Osvaldo dos Anjos², Allan Kardec Duailibe Barros Filho³, Fulvia Vera de Martinez⁴, Fabrício Moraes de Almeida⁵, João Viana Fonseca Neto⁶, Charles da Silva Barata⁷, Lenita Rodrigues Moreira Dantas⁸, Fabio Robson Casara Cavalcante⁹

¹PhD in Health Sciences - University of Brasília - UnB, Brazil; PhD in Science - University of Havana (Cuba); Post-Doctor in Health Sciences - UnB and Degli Studi D'Aquila University - IT. Professor at the Federal University of Maranhão, Brazil. E-mail: carlos.paraguassu@gmail.com

²Master in Environmental Management - University of São Carlos - Paraguay. Researcher at the Higher Institute of Health Sciences and Environment of the Amazon – AICSA, Brazil.

³PhD in Information Engineering. Universidade de Nagoya – Japan; Post-Doctor. The Institute of Physics and Chemistry (RIKEN), Japan. Professor at the Federal University of Maranhão, Brazil.

⁴PhD in Education sciences. Inter-American University – Paraguay. Professor at the University of San Carlos, Paraguay.

⁵PhD in Physics (UFC), with post-doctorate in Scientific Regional Development (DCR/CNPq). Researcher of the Doctoral and Master Program in Regional Development and Environment (PGDRA/UNIR). Leader of line 2 - Technological and Systemic Development, and Researcher of GEITEC — Federal University of Rondônia, Brazil.

⁶PhD in Electrical Engineering. Federal University of Paraíba, Brazil. Professor at the Federal University of Maranhão, Brazil.

⁷Master in Geography - Federal University of Rondônia. Researcher at the Higher Institute of Health Sciences and Environment of the Amazon – AICSA.

⁸Graduated and Specialist in Geography. Graduated in Law. Researcher at the Higher Institute of Health Sciences and Environment of the Amazon – AICSA, Brazil.

⁹PhD in Sciences: Socio-environmental development - NAEA / UFPA. Associate professor, Federal University of Rondônia – UNIR, Brazil.

Abstract

*The struggle for a fair distribution of land consolidated social movements and put pressure on the Brazilian government to carry out agrarian reform. The government allocated rural workers to the settlements and created programs to strengthen family farming. The global concern with the sustainability of the planet has led scholars to think that family farming is an alternative for the reduction of poverty and for the preservation of the environment. Based on this principle, the **objective** of this study was to analyze whether family farming used in the family units of the Joana Darc III settlement in Rondônia contributes to sustainable development. **Materials and methods:** The research is characterized as descriptive and a case study. We use an instrument developed by Anjos¹⁷, semi-structured, divided into 6 blocks:*

*Identification of the profile of farmers; Characterization of the production unit; Characterization of crop production; Production commercialization; Financing and infrastructure and, Life conditions. The sample granted for accessibility was a group formed by 30 (26.3%) rural farmers from the Joana Darc III settlement who cultivate different crops, harvested from a population of 114 farmers. For the sample size, the systematic sampling formula presented by Barbetta²⁶ was used. The research project considers the ethical aspect and is in accordance with CNS Resolution 196/96. **Results:** The results showed that the settlers received financing from Pronaf for investments in increasing production and technical assistance from EMATER. However, the production system adopted is traditional, with the use of pesticides in crops and the use of pesticides in animals and they practice burning to clean the land. This practice goes against the principles of clean agriculture, which aims to preserve the environment. It was also found that the settled farmers sell their products below the market price, reducing their profit margin. However, all were unanimous in ensuring that they would have better living conditions compared to the life before the settlement and believe in improvements in the future. **Conclusions:** It was rejected the hypothesis that family farming used in the family units of the Joana Darc III settlement in Rondônia contributes to sustainable development.*

Keywords: Family farming. Sustainable development. Rural settlement. Rondônia. Brazilian Amazon

I. INTRODUCTION

Family farming can be defined as the set of agricultural productive units with exploitation under a family economy regime, comprising those activities carried out on small and medium-sized properties, with labor from the family itself¹. For these authors, family farming is fundamental for the sustainable economic development of rural areas. Family production is the main economic activity in several Brazilian regions and needs to be strengthened, as the potential of family farmers in generating jobs and income is very important.

According to Martins², family farming is an institution for the reproduction of the family, whose core is in the direct relationship with the land and with agricultural production. According to Bittencourt³, it is necessary to stimulate the participation of family farmers in public policies in Brazil, guaranteeing them access to land and credit, conditions and technologies for the production and sustainable management of their establishments, in addition to guarantees for commercialization of their products, agricultural or not.

For Abramovay⁴ family farming is one in which management, property and most of the work come from individuals who maintain blood or marriage ties. This definition is not unanimous. It is perfectly understandable, since the different social sectors and their representations build scientific categories that will serve certain practical purposes: the definition of family farming, for the purpose of granting credit, may not be exactly the same as that established for the purpose of statistical quantification in an academic study. The important thing is that these three basic attributes (management, property and family work) are present in all of them.

Family exploitation must be analyzed as a whole, that is, taking into account several entities that structure it. Understanding its functioning means highlighting the different logics according to which the farmer determines his fundamental choices. These logics are defined in relation to a certain number of systems⁵. In this sense Abramovay⁶ understands that family farming is not such a widespread phenomenon that it cannot be explained by the historical peasant heritage, in fact, in some existing cases, in fact, the State was decisive in shaping the current social structure of the agrarian capitalism of nations central. Family farming, highly integrated into the market, capable of incorporating the main technical advances and responding to government policies cannot be characterized as a peasant by any means.

For Martins², reproduction strategies are not limited to reproducing, that is, subsisting and remaining. They also address new needs and new challenges that are continually generated by economic and social changes. Family farming characterizes a form of production organization in which the criteria used to guide decisions related to exploration are not only seen from the angle of production / economic profitability, but also consider the objective needs of the family, says Hecht⁷.

According to Brazilian legislation (Law 11.326 / 2006) family farmers are those who practice activities in rural areas, have an area of up to four fiscal modules, family labor and income linked to the establishment itself and management of the establishment or enterprise by family members. Also included in this classification, in addition to agrarian reform settlers, are foresters, aquaculturists, extractivists, fishermen, indigenous and quilombolas. According to Abramovay⁴, family farming has the following characteristics: a) Management is done by the owners; b) Those responsible for the company are linked by kinship; c) The work is fundamentally family; d) The capital belongs to the family; e) The assets are subject to inter-managerial transfer within the family; f) Family members live in the production unit.

In the 1990s, the family farming category was adopted by the Brazilian State itself, when formulating a vast support program for farmers (PRONAF), whose activity was organized by and for the family⁸. The National Program for Strengthening Family Agriculture (PRONAF) has the purpose of promoting the sustainable development of the rural segment made up of family farmers, in order to provide them with an increase in productive capacity, the generation of jobs and the improvement of income^{9; 10}.

According to Mattei¹¹, PRONAF was structured with the following specific objectives: a) to adjust public policies according to the reality of family farmers; b) make the necessary infrastructure feasible to improve the productive performance of family farmers; c) raise the level of professionalization of family farmers through access to new standards of technology and social management; d) stimulate these farmers' access to input and product markets.

According to the Government of Brazil portal, family farming plays an important role in the Brazilian economy. With annual sales of US \$ 55.2 billion, if the country had only family production, it would still be in the top 10 of the world agribusiness, among the biggest food producers, behind only China, India, Indonesia, Nigeria, Pakistan and Japan.

These data are part of a comparison between data from the World Bank and the Ministry of Agriculture, Livestock and Supply. In Brazil, when adding family farming to all food production, it goes from eighth to fifth position in the world, with revenues of US \$ 84.6 billion per year. It is evident that the growth of Brazil goes through family farming. According to the Brazilian Agricultural Census, family farming is the basis of the economy of 90% of Brazilian municipalities with up to 20 thousand inhabitants.

In addition, it is responsible for the income of 40% of the economically active population in the country and for more than 70% of Brazilians employed in the countryside. Family farming produces 70% of Brazilian beans, 34% of rice, 87% of cassava, 46% of corn, 38% of coffee and 21% of wheat. It is also responsible for 60% of milk production and 59% of the pig herd, 50% of poultry and 30% of cattle.

When it comes to family farming and sustainable development, most authors remember that the term sustainable development was used for the first time in 1987 by the United Organizations (UN) when presenting their study entitled “Our Common Future” that recommended actions to preserve the environment. In the document, the UN defines sustainable development as one that meets present needs, without compromising the ability of future generations to meet their own needs.

In Brazil, concern for the environment is recorded in Article 225 of the Brazilian Constitution of 1988, which says: everyone has the right to an ecologically balanced environment, a common use of the people and essential to a healthy quality of life, imposing power public and the community the duty to defend and preserve it for present and future generations¹².

This initiative brings Brazil into conformity with the global concept of sustainable development, as it combines the preservation of the environment through the conscious use of natural resources and the preservation of the quality of life of individuals. Requires the development of individual and collective actions with the participation of society to reverse climate change. Individuals were invited to participate in environmental preservation and contribute to a better and more sustainable world.

Due to its complexity, sustainable development crosses the frontiers of environmental issues and embraces social and economic issues. This tripod, called the sustainability tripod, aims that the actions of companies must be economically viable, socially just and ecologically correct¹³. In this logic, companies to be competitive would have to worry about people, as the author said, “If they want to stay in the market, companies should also think about the well-being of society, which includes preserving natural resources, using them properly and without compromising well-being ”¹³.

Thus, the challenge of producing ethically was launched, considering the balance between man and nature. Since the dawn of humanity, man in the search for survival has sought to dominate nature and in this struggle, he committed irremediable abuses that at the present moment compromises the permanence of individuals on the planet. Trying to minimize this damage has become the goals of nations that organize and discuss ways and actions to reverse the damage caused to the environment, as well as less harmful forms of production. Regarding agricultural production, it has been proven by several studies that agriculture is also largely responsible for the ecological imbalance.

In Batalha¹⁴'s view, “The effects of agriculture on the environment have become the subject of great discussion and concern [...]”. This statement starts from verifying the use of technologies used in Brazilian agribusiness. It is noticed that agriculture as it has been developed has not adopted measures for the conscious use of natural resources¹⁵. Concerning the environment today has become a competitive differential for properties (companies), as this attitude generates a positive image and highlights the product in the market. Producing sustainably, respecting the conditions of the environment allows rural producers to reduce production costs and enter new markets with an environmentally friendly product, gaining a competitive advantage.

The preservation of the environment, the conservation of water resources must be a priority

for rural agriculture, however, very little has been done for its effectiveness. Adaptation initiatives for sustainable agriculture most often meet economic interests contrary to their implementation. In this vein, Pedroso¹⁶ states that "the paths to building a sustainable rural development model in Brazil are the expansion, viability and strengthening of family farming and the promotion of ecological technology that conserves natural resources". In this sense, producing without harming the environment and contributing to local development has become an objective for all producers and for family farming.

According to Anjos¹⁷, the debate around the importance of family farming as an element conducive to sustainable development has evolved in recent years. For Damasceno, Khan and Lima¹⁸, family farming has contributed strongly to the country's economy. According to these authors, family farming plays a fundamental role in the social development and balanced growth of the country. The millions of small producers that make up family farming make it an expanding and vitally important sector for Brazil. Every year, family farming moves billions of reais in the country, producing most of the foods that are consumed on Brazilian tables. In addition, it contributes to job creation, income generation and distribution and a reduction in rural exodus.

According to Martins², despite the importance of family farming, these workers who work on a small plot of land, usually using family members as labor, face difficulties ranging from particular needs, going through economic issues to technical issues related to vocational training, land management and care. For Anjos¹⁷, the settlers of Joana Darc III are workers who together (as a family) migrated from other regions in search of a piece of land to cultivate and live on family farming. According to Sousa, Passos and Khan¹⁹ family farmers in general face great difficulties to produce and also to drain their production, as well as to have a quality life in rural areas. When dealing with settled farmers, the difficulties increase, since they are located in regions that are never inhabited and, consequently, lacking all that is necessary for a dignified life.

For Anjos¹⁷ in the Joana Darc III settlement, infrastructure issues and support public policies are in need of a solution since its foundation. Public agricultural costing policies are essential for the development of the settlement, not only for the economic aspect, but also for the social aspect, as it would strengthen family farmers. The Joana Darc III settlement was established based on the population strategy of the State of Rondônia and was formed by farmers from various States and municipalities in Rondônia.

According to Anjos¹⁷, land conflicts in the Amazon, especially the conflict known as the "Corumbiara massacre", which occurred in 1995 in the municipality of Corumbiara, in the state of Rondônia, and the conflict that occurred in Eldorado dos Carajás, in Pará, were historical events that strengthened and inspired workers in the struggle for land and in the strategy for the occupation of non-productive land in the Amazon. And it was due to pressure from society and international repercussion, that the Brazilian government authorized the creation of some settlements in the Amazon and in this political effervescence the Joana Darc III settlement was born. In this sense, the research aims to analyze the family farming used in the family units of the Joana Darc III settlement, in Rondônia and its contribution to sustainable development in the Amazon.

II. MATERIALS AND METHODS

2.1 Study Type

The research is characterized as descriptive and a case study. Gil²⁰, states that the descriptive research aims to study the characteristics of a group: it describes the population and uses standardized data collection techniques such as, questionnaire and systematic observation^{20; 21; 22; 23}. Bruyne, Herman, Schiutheete²⁴ says that case studies allow the application of equally varied information gathering techniques (observations, interviews, documents) to generate an analysis of an organization or measure some performance. In Yin's²⁵ view, the case study type of research seeks to broaden and generalize theories based on theoretical analysis and not only from a statistical perspective.

2.2 Semi-structured instrument model used in the research

We use an instrument developed by Anjos¹⁷, semi-structured, divided into 6 blocks: (a) Block I - Identification of the profile of farmers; (b) Block II – Characterization of the production unit; (c) Block III – Characterization of crop production; (d) Block IV – Production commercialization; (e) Block V – Financing and infrastructure and (f) Block VI – Life conditions.

Block I - The identification consists of the following variables: Genre, Age Range, Marital Status, Number of children, Education, Birthplace, Position in the family, If you own the land, Some family member receives some external income, Some family member works outside the settlement, Someone in the family resides outside the settlement, Before the settlement he worked in agriculture, What is the main source of income, Main performance as a farmer, How did you discover the existence of the settlement and How was the participation in the struggle for land.

Block II - characterization of the production unit consists of the following variables: Property size, Size of planted área, Unused área, Reserve área, Area reserved for use of pastures, Way to develop productive activities, Collective use of machinery and equipment and Equipment socialization / Association.

Block III - characterization of agricultural production with the following variables: Temporary crops, Permanent crops, Has environmental concern, Uses chemical fertilizers and Receives technical help from EMATER.

Block IV - production and consumption with the following variables: Most commercialized products, Production distribution, Where do you sell products and What are the difficulties in marketing the products.

Block V – Financing and infrastructure with the following variables: Access to financing credit, Financing credit amount, Purpose of the credit, Credit source, Bureaucracy for access to credit, Settler status is a privilege for acquiring credit and Bureaucracy for the settlement of credit.

Block VI – Life conditions with the following variables: Home, Health service, Access to water, Access to credit, Food, Education, Recreation, Income, Work conditions, Physical security, Religious practice, Outlook for the future and Residence structure.

2.3 Sampling Number

The sample granted for accessibility was a group formed by 30 (26.3%) rural farmers from the Joana Darc III settlement who cultivate different cultures, harvested from a population of 114 farmers

residing in the rural settlement. To calculate the sample size, it is necessary to use some statistical method. In this sense, the systematic sampling formula presented by Barbetta²⁶ was used, being:

$$n_0 = \frac{1}{(E_0)^2} \cdot \frac{N \cdot n}{N + n_0}$$

$$(E_0)^2 \cdot N + n_0$$

Where:

N = size (number of elements) of the population,

n = sample size (number of elements),

n₀ = a first approximation of the sample size,

E₀ = tolerable sampling error.

Toledo and Ovalle²⁷ defines the sample as a subset of the population from which a value judgment is created regarding universal characteristics. According to Kazmier²⁸, as the sample size increases, the distribution of the mean sampling approaches the form of the normal distribution, whatever the form of the population distribution. This author argues that, for a sample to be meaningful, it must contain 30 or more elements in the research universe.

2.4 Inclusion and exclusion criteria

The survey included workers who owned areas in the Joana Darc II family farming project, regardless of gender and who offered to sign the Free and Informed Consent Form. Workers under 18 and those who did not sign the Informed Consent Form were excluded.

2.5 Ethical Aspects

The research project is in compliance with Resolution 196/96, which deals with research with human beings, of the National Health Council of Brazil. The participating subjects are volunteers and were submitted to the interview and application of the forms after signing the Free and Informed Consent Form.

2.6 Research Location

The Joana D'Arc III settlement is located on an area of 17,509,0145 hectares. Of these, 6,634,5052 ha, was reserved for the six agrovillages that make up Joana Darc III. Each agrovila can house 24 settled families. The Rural Settlement Joana D'Arc III, is located 100 km from the urban perimeter of the municipality of Porto Velho in the State of Rondônia. The settlement is located in an area that is difficult to locate. Access is possible through the Federal Highway BR 319 that connects Porto Velho to Manaus, State of Amazonas or through the Federal Highway BR 364 that connects Porto Velho to Rio Branco in the State of Acre.

According to records from the National Institute of Colonization and Agrarian Reform (INCRA), the Joana D'Arc III Rural Settlement was created on June 9, 2000. The deliveries of properties by INCRA started in April 2001, however, before going to agrovilas, the settlers were camped in the District of Jaci Paraná where they stayed for approximately one year.

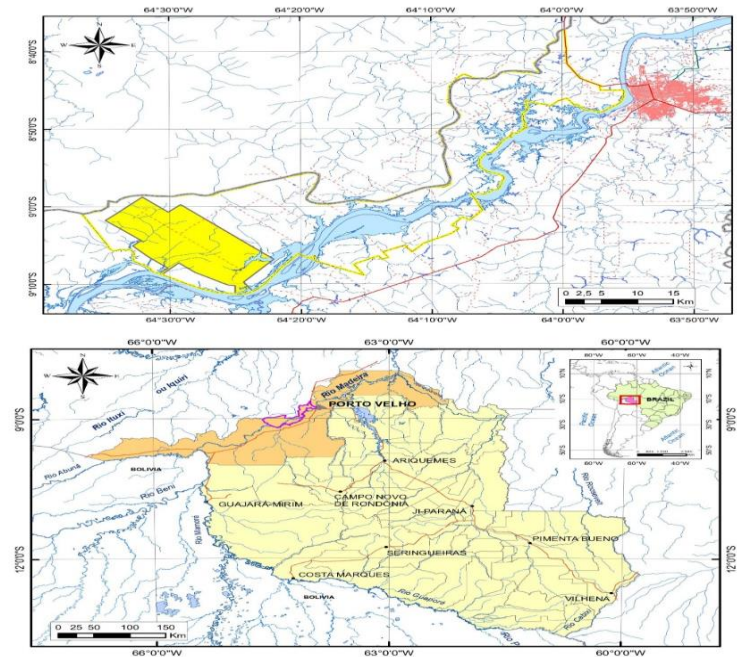


Figure 1: Map of the geographical location of the Joana Darc III settlement project in a rural area in Porto Velho, Rondônia.



Figure 2: Map of the Joana Darc III settlement project location.

2.7 Data Collection Technique and Analysis Model

Gil²⁰ asserts that the data collection technique in a case study is used to: a) explore real-life situations whose limits are not clearly defined; b) describe the situation of the context in which a given investigation is being carried out; c) explain the causal variables of a given phenomenon in very complex situations that do not allow the use of surveys and experiments. Lakatos and Marconi²¹ adds that the technique for collecting data in research in the case study model is carried out by combining several processes, of which, direct observation, document analysis, the interview and the life story are the most

used. The questionnaire was adopted as the first choice, however the difficulty of understanding of some respondents due to the low level of education, in some cases assumed the character of an interview.

Gil²⁰ points out that it is common to use more than one instrument in this type of case study research. Several researchers have been working to study family farming production methods. Therefore, the data collection instrument was semi-elaborated, contemplating some questions considered essential to identify the settlers and answer the research questions of this study.

2.8 Statistical Analysis of the Data

The data were tabulated and then compiled into an Excel Microsoft Windows 10 table, in order to facilitate understanding and trace the understanding of what occurs in the researched settlement and thus respond to the research objectives²³.

III. RESULTS AND DISCUSSION

(a) Block I - Identification of the profile of farmers

From a universe of 114 farmers settled in the Joana Darc III agricultural project, 26.3% of the landowning farmers were interviewed, 70% male and 30% female. Male farmers still predominate in rural settlements and agricultural production activities. As for the age group, it was found that 10% of respondents are in the age group between 30 and 40 years, 50% are between 41 and 50 years and 40% are in the range of 51 to 60 years.

Farmers of both sexes under the age of 50 correspond to 60%, that is, according to the study sample, farmers constitute a young and productive population. Regarding marital status, 90% were married (in a stable relationship) and 10% had divorced. All divorced / separated were female, where their husbands (partners) abandoned them. These women have become breadwinners and continue to work in agriculture. However there are also women even though they are not divorced they are family leaders.

Regarding the number of children, 20% have no children, 20% have only 1 child, 30% have 2 children and 30% have 3 children. It was found that farmers follow the same pattern as urban families, where the number of children is increasingly reduced. In the study by Bezerra and Schlindwein²⁹, an average of three people per rural property was found, with a minimum of one resident and a maximum of seven residents. Referring to the school level, 20% of the respondents have high school level and 80% have only the elementary school level. This reality highlights the need to train rural farmers, with education focused on the countryside. It is noticed that most farmers do not have technical training, an essential characteristic for their activity.

Thirty percent of family farmers have their origin in the State of Minas Gerais (Southeast Region of Brazil), 20% were born in the State of Amazonas (North Region of Brazil) and 50% were born in the State of Rondônia, coming from several municipalities. All farmers participating in the sample are primarily responsible for supporting the family, as it says in Brazil, they are the heads of families. They are also the owners of the land. No member of the family receives any kind of foreign aid. No family member works in another activity outside the rural settlement. No family member resides outside the rural settlement.

As for the bond with the land, 20% planted on their parents' land, 10% already owned land and planted on their own land and 70% carried out their plantations on rented land. It is evident in this matter that the land is generally not owned by those who cultivate, hence the struggle for land reform and for more equitable use and possession of the land.

The family's source of income comes from agriculture and none of its members has help from third parties or the government. Keeping their family formation, they work together since they received the land and live on what they can produce. Only one farmer claimed that a son left the settlement and went to live in another city in order to study. The rest remain with the whole family working in the fields. Regarding his role as a farmer, 90% identified his main occupation as a farmer and 10%, his main occupation was livestock.

This quantity is valid for this research since it considered the answers from the perspective of farmers. As for the knowledge of the existence of the settlement, 80% had this information through the association, 10% knew about the formation of the settlement through friends and 10% were resettled, that is, they came from another camp or settlement, having not been asked the origin. As for the struggle for land, 80% fought together with the association / union and 20% replied that they did not fight to establish themselves in Joana Darc III.

Table 1: Identification of the profile of settlers.

Genre	Fa*	Fr%
Male	21	70.0
Female	9	30.0
Age Range	Fa*	Fr%
30-40	2	10.0
41-50	15	50.0
51-60	12	40.0
Marital Status	Fa*	Fr%
Married	27	90.0
Separated / Divorced	3	10.0
Number of children	Fa*	Fr%
Do not have children	6	20.0
Has 1 child	6	20.0
Has 2 children	9	30.0
Has 3 children	9	30.0
Education	Fa*	Fr%
Complete primary education	24	80.0
High school	6	20.0
Birthplace	Fa*	Fr%
Amazonas	6	20.0
Minas Gerais	9	30.0
Rondônia	15	50.0

Position in the family	Fa*	Fr%
Householder	30	100.0
Not householder	0	0.0
If you own the land	Fa*	Fr%
Yes	30	100.0
No	0	0.0
Some family member receives some external income	Fa*	Fr%
Yes	0	0.0
No	30	100.0
Some family member works outside the settlement	Fa*	Fr%
Yes	0	0.0
No	30	100.0
Someone in the family resides outside the settlement	Fa*	Fr%
Yes	0	0.0
No	30	100.0
Before the settlement he worked in agriculture	Fa*	Fr%
Yes	30	100.0
No	0	0.0
What is the main source of income	Fa*	Fr%
Agriculture	27	90.0
Agriculture + Livestock	3	10.0
Main performance as a farmer	Fa*	Fr%
Farmer	27	90.0
Livestock	3	10.0
How did you discover the existence of the settlement	Fa*	Fr%
Farmers Association	24	80.0
Friends	6	20.0
How was the participation in the struggle for land	Fa*	Fr%

By the association	24	80.0
Did not participate in movement for land	6	20.0

Fa* Absolute frequency **Fr%** Relative frequency

(b) Block II – Characterization of the production unit

According to research data, farmers received an area of 50 hectares of land for use, that is, each family received an area of the same size without distinction of the size of the family (Table 2). The transfer of public domain land was carried out by INCRA, the government agency responsible for this activity. On this subject Francisco³⁰ announces that the agrarian reform aims to provide the redistribution of rural properties, that is, to effect the distribution of land for the realization of its social function. This process is carried out by the State, which buys or expropriates land from large landowners (owners of large tracts of land, most of which are not usable) and distributes it to peasant families. In the study by

Bezerra, Schlindwein²⁹ the size of rural properties varied from 1 hectare to 100 hectares. The average size of the surveyed properties was 14.76 hectares. The highest percentage (52.20%) corresponds to properties with up to 10 hectares, which represents a concentration of people with little space (ha) to produce. When properties ranging from more than 10 to 60 hectares are analyzed, only 46.70% of the sample falls within this range and 1.1% has more than 60 to 100 hectares²⁹. According to data from Sangalli³¹, the average hectares of family farmers in the Lagoa Grande settlement, located in the municipality of Dourados, MS, is 25.9 ha and, based on INCRA data³², the average hectares of farmers belonging to the Amparo settlement, also in the municipality of Dourados-MS, is 16.8 ha. Given these data, different authors point out that a limiting factor for the production of family farming is the small area of land^{33; 34}. Each family of farmers produces and uses the land according to their perspectives.

Thus, the planted areas are thus distributed: 20% use only 5ha for cultivation; 10% use 10ha; 10% produces in 10ha; 20% produces in 20ha; 10% produces in 30 ha and 30% cultivates in 40 ha. (Table 2). When asked about the condition of the area, 40% said they had unused area on their plot and 60% claimed that all areas are used. (Table 2).

Regarding the reserve area, 40% claimed that their land has a reserve area and 60% that their land does not extend into the reserve area. (Table 2). Regarding the area intended for pasture, 30% claimed that they reserve 10 ha for pasture; 10% says to reserve 20 ha; 20% says to book 30 ha; 10% says to reserve 35 ha; 10% says to reserve 40 ha e 20% says to reserve 45 ha for pastures. (Table 2).

This data draws our attention to the amount of hectares reserved for cattle pastures. This can lead to the demystification of the idea that agrarian reform is carried out for the cultivation of land. Although the study portrays a specific situation in the analyzed settlement, it raises interest in evaluating other settlements to compare the reality. It was observed that the use of the territory for grazing does not include sustainable methods. There is only an economic concern. Regarding the way to carry out the productive activities, everyone produces and performs the tasks individually.

The only situation in which he performs collective work is in the socialization of the equipment used in the association, where 60% share the equipment with 15 more members and 40% share the equipment with 20 more members. Regarding the collective organization of farmers, Roos³⁵ warns that

the settled peasants, organized or not in Movements of the Land, see in the collective associative actions in the settlements a way to guarantee their maintenance and existence in the countryside. This organization of the settlers does not take place only in the productive sphere, but also in political and solidarity relations, that is, through collective struggles such as protests, walks, varied assistance in land occupations, road closures, joint efforts, etc.

Although they carry out their production individually, farmers are organized to strengthen themselves and demand better working conditions and quality of life. The area received by the farmers was the same size for everyone, however, when asked about the planting area, the answers came out unevenly, since each settler produces and uses the land according to their perspectives.

Table 2: Characterization of the production unit

Property size	Fa*	Fr%
50 hectares	30	100.0
more than 50 hectares	0	0.0
Size of planted area	Fa*	Fr%
5 hectares	6	20.0
10 hectares	3	10.0
15 hectares	3	10.0
20 hectares	6	20.0
30 hectares	3	10.0
40 hectares	9	30.0
Unused area	Fa*	Fr%
Yes	12	40.0
No	18	60.0
Reserve area	Fa*	Fr%
Yes	12	40.0
No	18	60.0
Area reserved for use of pastures	Fa*	Fr%
10 hectares	9	30.0
20 hectares	3	10.0
30 hectares	6	20.0
35 hectares	3	10.0
40 hectares	3	10.0
45 hectares	6	20.0
Way to develop productive activities	Fa*	Fr%
Individual productive activities	30	100.0

Individually grown products	30	100.0
Collective use of machinery and equipment	Fa*	Fr%
Yes	30	100.0
No	0	0.0
Equipment socialization / Association		
With 15 associates	18	60.0
With 20 associates	12	40.0

Fa* Absolute frequency **Fr%** Relative frequency

(c) Block III – Characterization of crop production

The surveyed farmers temporarily grow 10% crops of pineapple, pumpkin, banana, vegetables, yams, oranges, coffee, papaya, corn and watermelons respectively and, as a permanent crop, 50% grow cassava, 20% concentrate on Galician lemon plantation and 30% of farmers produce coffee. Although 100% say they are concerned with environmental preservation, in the same relative frequency (100%) of farmers make use of chemical fertilizers (pesticides). One hundred percent of farmers receive technical assistance from EMATER. According to Almeida and Kudlavicz³⁶, land is synonymous with life and work and, without a doubt, family farmers have been working hard to achieve a decent life in rural areas. Through the cultures they cultivate, they seek different strategies, such as diversification, to generate income. Production in the Joana Darc III settlement follows the characteristics of family farming, with the cultivation of various crops and in small quantities.

According to data from the Brazilian Agricultural Research Corporation - EMBRAPA³⁷, cassava has a slow initial development, which allows, when intercropped, that other crops take better advantage of growth factors. It is recommended to plant cassava in a double row system, spaced 2.00 m apart. In this space, you can place three rows of beans or, still, two rows of corn. The rotating use of crops contributes to soil preservation and should be used following appropriate techniques. It was observed that settlers carry out plantations of temporary products and permanent products, but in both cases, the choice is made more by the seasonality of the product than by a technical choice, not taking advantage of the benefits that the crop rotation technique can provide.

According to Fancelli³⁸ to guarantee the efficiency of a crop rotation system, there are some basic principles, such as: alternating between plant species that have different nutritional requirements and that are not susceptible to the same types of pests; alternation between species with different root systems in terms of architecture, distribution and depth of soil exploration; use of at least one species with a high capacity to produce plant residues, which promote soil protection. The crop rotation technique allows the soil to remain in balance and to recover with the diversification of planting.

For Arnhold, Ritter and Balbinot³⁹ the application of an adequate crop rotation system has several advantages, among them: provides diversification in production; improves soil characteristics; assists in disease and pest control; makes the system more productive; promotes nutrient cycling and helps restore degraded areas. The proposed benefits of crop rotation would help surveyed farmers to have cleaner

production without using pesticides. Taking them to migrate from traditional production to organic production. The production and consumption of organic food represents significant values for the Brazilian economy and for the health of the population, being a form of social and economic sustainability of family farming⁴⁰. According to farmers, EMATER provides them with technical assistance, however, it is not aimed at sustainable planting. They follow traditional farming methods, using chemicals to combat pests and insects, including ticks on animals. Disregard the damage that this practice can cause in the medium and long term for those who are exposed to these poisons. Farmers replied that they are concerned with conserving water sources. Unanimously, all respondents had the same answer regarding water preservation. They are unaware, however, that the use of fertilizers and insecticides in animals will end up in the soil and consequently in streams, streams and rivers contaminating the environment⁴¹.

Table 3: Characterization of crop production

Temporary crops	Fa*	Fr%
Pineapple	3	10.0
Pumpkin	3	10.0
Banana	3	10.0
Vegetables	3	10.0
Yam	3	10.0
Orange and coffee	3	10.0
Papaya	3	10.0
Manioc	3	10.0
Corn	3	10.0
Watermelon	3	10.0
Permanent crops	Fa*	Fr%
Manioc	15	50.0
Galician Lemon	6	20.0
Coffee	9	30.0
Has environmental concern	Fa*	Fr%
Yes	30	100.0
No	0	0.0
Uses chemical fertilizers	Fa*	Fr%
Yes	30	100.0
No	0	0.0
Receives technical help from EMATER	Fa*	Fr%
Yes	30	100.0
No	0	0.0

Fa* Absolute frequency **Fr%** Relative frequency

(d) Block IV – Production commercialization

Cassava with 60% is the main product produced in the settlement, corn is the second product with 30% and coffee the third product with 10%. Of these products, 90% are sold and 10% are for own consumption. This also constitutes sustainable development, as the farmer supplies himself with his own harvest and, therefore, does not need to invest in the purchase of the basic basket of processed foods. Farmers sell 80% of their products in open markets and 20% in the rural settlement itself. The commercialization and distribution of products is a critical factor in any business and rural settlement is a concern. It is not enough to produce, it is necessary to plan the flow of production and therefore planting and marketing decisions must have the same importance.

According to Mendes and Padilha Junior⁴² commercialization is a continuous and organized process of forwarding agricultural production along a commercialization channel, in which the product undergoes transformation, differentiation and added value. According to Walquil et al⁴³ the rural producer must face the inherent adversities not only to the production and financing of the operational costs of the activities, but mainly to the future expectations regarding the quotations of the prices of agricultural products, influenced by historical trends, production seasonality and speculative movements causing significant price fluctuations.

According to settled farmers, when products are traded in the rural settlement itself, prices are very low. However, when the settler (producer) has a customer (buyer) it generates some tranquility. According to the settlers, this partnership sometimes turns into a financial aid, since when a financial emergency arises, they turn to the client and provide them with an advance. All production is consumed in the regional market. EMATER, the state government agency that supports the settlement, in partnership with the Joana Darc Producers Association (ASPROD'ARC), organizes a weekly fair, where producers can take their products and sell.

To become competitive, farmers seek to establish partnerships, collaborating mutually in the supply chain to generate value for the customer. The partnership can be understood as an arrangement between two or more parties that establish a cooperation agreement between themselves to achieve common interests. For the settlers, because they produce fruits, vegetables and other perishable products, disposal means total loss, so to avoid losses, a price reduction is carried out so that the product is sold, thus avoiding the cost of transportation back.

The greatest difficulty encountered by farmers in the marketing of their products is the transport of the goods. In this sense, 70% of the settlers claim that transportation is the main cause of difficulties in marketing, 10% claimed to have difficulty with the price and 20% of settlers said they did not have marketing problems. The price can be a factor of success or failure of a certain product, therefore, when pricing, internal and external variables must be considered. Transport is a problem, as EMATER only makes available a small truck, which does not meet the needs of all producers.

Logistics is vital for any business. It is what will make the product reach the right place, at the right time, adding value to the customer, however, 60% of the logistical costs, it is up to the transport raising the cost of the product and competitiveness in the market⁴⁴. The main role of transport logistics is to minimize the distances between producers and their respective customers by ensuring that the correct product is delivered as established in the contract. As the distance between the settlement and the fair is

large, producers use private cars and attach a body to be able to take the products. It is known of the great difficulty that family farmers face to produce and also to drain their production, as well as to have a quality life in rural areas²⁹. It was verified that in the rural settlement there is no storage of products. Distribution occurs directly from the harvest to the final consume.

Ballou⁴⁵ defends this situation. According to this author, this condition avoids the accumulation of stock that can be transformed into a loss due to perishability, burden logistics costs and thus reducing the profit of the producer. The logistical costs are linked to the activities of planning, implementing and controlling all materials and services from the moment of entry, through the moment of transformation until the moment of departure considering, from the place of origin to the final place of consumption, including also the discard¹⁴. The surveyed producers sell their products at a price lower than that practiced in the market by approximately 30%, however, judging by the 10% of the dissatisfied and by what is observed in loco, there is no study on pricing in this way, since the costs of production are unknown, the price charged may be causing losses to the producer.

Table 4: Production commercialization

Most commercialized products	Fa*	Fr%
Manioc	18	60.0
Corn	9	30.0
Coffee	3	10.0
Production distribution	Fa*	Fr%
Product Sales	27	90.0
Own consumption	3	10.0
Where do you sell products	Fa*	Fr%
Free fairs	24	80.0
On site	6	20.0
What are the difficulties in marketing the products	Fa*	Fr%
Transport	21	70.0
Low price	3	10.0
See no problems	6	20.0

Fa* Absolute frequency **Fr%** Relative frequency

(e) Block V – Financing and infrastructure

Every business needs financial resources to run production. Working capital is the necessary resource that the farmer needs to carry out his daily activities. In general, working capital stems from the difference between the farmer's available money and the money that will be used to settle his debts, be they fixed or variable expenses, expenses necessary to perform services, for marketing, among others.

The small rural farmer suffers from a lack of working capital and although there are lines of credit available for his category, they often do not have access due to the bureaucracy imposed by financial

institutions. In Brazil, to strengthen family farming, the government adopted a financing policy with the lowest market rates, ranging from 0.5% per year to 4.6% per year^{46; 47}. In the case of settlers, financing is essential for their permanence in the rural rural area, which is why the Government, through financial institutions, creates programs that grant credits to finance the production of settlers in a less bureaucratic way, through associations or cooperatives. The surveyed farmers declared that they invested the credit received in the production. The values of the credit granted by PRONAF are varied⁴⁷.

The reason for this variation or the criteria for release of the amount has not been researched. For the surveyed settlers, 10% obtained a credit of R\$ 40,000.00; 40% received R\$ 45,000.00; 20% received R\$ 50,000.00; 10% received 70,000.00; 10% received 80,000.00 and 10% obtained 95,000.00 credit. In this study, all settlers had access to PRONAF credit financing and used it to increase production. All claimed that there was no difficulty in acquiring the credit and that the fact of being a Joana Darc settler helped a lot in releasing the values. When asked if it was difficult to repay the loan, 90% of respondents claimed that no, only 10% settlers said they had difficulty paying off the debt.

Table 5: Financing and infrastructure

Access to financing credit	Fa*	Fr%
Yes	30	100.0
No	0	0.0
Financing credit amount	Fa*	Fr%
R\$ 40,000.00	3	10.0
R\$ 45,000.00	12	40.0
R\$ 50,000.00	6	20.0
R\$ 70,000.00	3	10.0
R\$ 80,000.00	3	10.0
R\$ 95,000.00	3	10.0
Purpose of the credit	Fa*	Fr%
Production	30	100.0
Other activities	0	0.0
Credit source	Fa*	Fr%
Pronaf Investment	30	100.0
Another source of investment	0	0.0
Bureaucracy for access to credit	Fa*	Fr%
Yes	0	0.0
No	30	100.0
Settler status is a privilege for acquiring credit	Fa*	Fr%
Yes	30	100.0

No	0	0.0
Bureaucracy for the settlement of credit		
There was no difficulty	27	90.0
There was difficulty	3	10.0

Fa* Absolute frequency **Fr%** Relative frequency

(f) Block VI – Life conditions

Andrade et al⁴⁸ clarifies that the term seated denotes the action of third parties on workers, hiding a previous action from those who, before being allocated, fixed, settled, fought hard for the right to cultivate the land. Before being settled, they were bóias-frias, squatters, small landowners who lost their land, small tenants, all in search of land to cultivate. These workers are never remembered by the state bureaucracy as occupiers, which implies a recognition of their action aimed at transforming idle land into cultivated land. In characterizing them as settlers, the State emphasizes its own action on those who insist on considering them as beneficiaries and not as subjects.

In the criticism of Andrade et al⁴⁸, the settler is seen as the individual who received help from the Government and not, the citizen who turns idle land into productive land, as occurs in the Joana Darc III settlement. Respecting the individual history of each one, the farmers of Joana Darc III organized themselves and fought for better living conditions based on an inhospitable reality. Although they faced great obstacles in arriving at the settlement, they managed to improve living conditions in several aspects. The negative aspect was leisure, where 60% of the interviewees stated that it worsened after arriving at the settlement and 40% said that they remained in the same condition as the previous place of residence.

Although there is a central (circular) connection area for all leisure areas, no public policy or initiative by the settlers has been carried out to transform this space into a common leisure place for everyone in the settlement. Leisure is necessary for human life, as it brings health benefits, improving the quality of life. According to Melo⁴⁹ "there is a direct relationship between leisure and health, leisure and education, leisure and quality of life, which cannot be neglected". In this way, it is necessary to create actions that can minimize not only the lack of leisure, but also deficiencies in education, physical security and religious practice. It is worth mentioning the improvement in the structures of the residences and in the perspective of the future, where all respondents pointed out that there was an improvement. It is evident when analyzing table 6 that there was a general improvement in the quality of life of the respondents and a recovery of their citizenship.

Quality of life is the process used to assess the living conditions of a human person, that is, it is the set of conditions that collaborate for the physical and spiritual well-being of individuals in social life⁵⁰. The improvement in the living conditions of the settlers was evident, however, the data collected were insufficient to assess the public improvement policy that presents the conditions of access to food, education, leisure and security, as pointed out in the data.

Table 6: Life conditions

Life conditions	Improved	Worsened	Equal
Home	30		
Health service	20		
Access to water	30		
Access to credit	30		
Food	27		3
Education	21		9
Recreation		18	12
Income	30		
Work conditions	30		
Physical security	9	6	15
Religious practice	3	3	24
Outlook for the future	30		
Residence structure	Improved	Worsened	Equal
Current brick house construction	30		

Fa* Absolute frequency

Family farmers are of great importance for the growth of Brazil^{46; 47}. It is up to the agriculture to be efficient and effective in the use of natural resources and to have the capacity and flexibility to adapt to environmental demands, minimizing negative impacts. It must realize and produce within a sustainable agricultural system what, in the definition of Farshad and Zinck⁵¹, is a system that is politically and socially acceptable, economically viable, agrotechnically adaptable, institutionally manageable and environmentally sound.

Corroborating with the aforementioned authors, Avarenga, Fernandes and Campos⁴¹ add that sustainable agricultural systems allow for productive, financial and environmental sustainability and provide food security for the rural population. It should also be noted that family farming currently maintains around 12 million people economically active in the countryside, who contribute to the development of the interior of the country and still ensure quality food for Brazilians^{46; 47}. When analyzing the mode of production of family farming, it is noticed that they are mixed modes, since several characteristics are included in their way of producing.

The sustainable practice and the criteria to be adopted transport us to the primitive mode where the cultivation and the result of the harvest were carried out collectively (today, by the family nucleus). The means of production are minimal, but they have a great responsibility to conserve the soil, water resources, fauna and flora resources, without causing impacts on the environment. Sustainable production becomes a challenge since it is not limited to the technological issue, but also to socioeconomic determinants that determine what is produced, how it is produced and for whom it is produced. These new strategies must have technological, social and economic dimensions⁵². Therefore, the changes would be a

form of organization of production that, by including elements of another technical pattern of production, forms another character in agriculture: the alternative-sustainable farmer⁵³.

The production method aimed at sustainable development in terms of agricultural practices, according to Veiga⁵⁴ stands out for the long-term maintenance of natural resources and agricultural productivity; minimal adverse impacts on the environment; adequate returns to producers; production optimization with minimal external inputs; meeting human needs for food and income; meeting the social needs of families and rural communities. When discussing the mode of production in the perspective of sustainability, Carmo⁵⁴, states that those who have little land and use diversification in food production are better able to develop sustainability in agriculture, because they can and are able to operate on a smaller scale, with the diversification and integration of agricultural and livestock activities, in addition to working and managing the establishment itself.

For small producers, diversifying agriculture is not a cultivation technique, but rather a measure of survival, since diversified systems reduce investment, costing and technological adequacy expenses. Crop rotation allows for a greater balance in income due to different crop periods. The results pointed out in the research leave evidence that, in practice, the triplet of social, economic and ecological components and their bearable, viable and equitable variables still cannot achieve the efficiency of sustainable development. The cultivation model of traditional culture, the excessive use of pesticides, the practice of burning to clean the area, insecurity in marketing, difficulties in accessing the consumer market, are still obstacles to be overcome.

IV. CONCLUSIONS

Understanding the issue of family farming as a factor of sustainable development is a major challenge, as the conditions for obtaining it are not yet fully met. The agrarian reform format adopted in Brazil fails to solve the problems that impact family farming, although family farming is a prominent sector in Brazil's economic and social development.

The proposal to revalue the rural environment as a space for production, housing and leisure, and with the emergence of the discussion on food and nutritional security, created an opportunity for those peripheral regions that are characterized by strong social inequalities, to organize structural reforms. In this perspective, the settlements become a conducive to the development of family farming, being seen as the social form capable of producing food, with the objective of guaranteeing food and nutritional security for society.

The accomplishment of this work enabled the understanding of the construction process, evolution and current configuration of the Joana Dar III settlement in Rondônia, as well as the ways of planting, production, commercialization and the living conditions of the settlers.

The agriculture practiced by family farming in the settlement, does not contribute to sustainable development, since it disregards the environmental pillar and 60% of the settlers practice production in a traditional way, although EMATER offers cultivation improvement techniques. Despite the improvement in the living conditions of farmers from living in the settlement, sustainability has not yet taken place as a result of the forms of cultivation.

Public policies aimed at family farming are incipient. Permanent cultivation is based on the production of cassava, coffee and corn, crops that do not require major investments, care or irrigation and which are the main source of commercialization. There is a reflex of improvement in the quality of life of the settled farmers, although it is based on the conception and perception that the family farmer has of himself and his history and previous life condition.

The results of the study refute the hypothesis that family farming used in the family units of the Joana Darc III settlement contributes to sustainable rural development, in the full sense of the concept and definition of sustainability.

However, it is evident in this context that the settlement of family farming in the Amazon is a fairer form of land distribution and an instrument capable of reducing social injustices in the rural area. However, it is not enough to have only the land. It is necessary to be able to live on this land and for that it requires articulating with other organizations that contribute to the population of the settlement to have a dignified life condition.

REFERENCES

1. Soares IF, Melo AC, Chaves ADCG. A Agricultura Familiar: Uma alternativa para o desenvolvimento sustentável no município de Condado – PB. INFOTECNARIDO (Mossoró – RN – Brasil) v.3, n.1, p.56-63 janeiro/dezembro de 2009.
2. Martins JS. Ímpares sociais e políticos em relação à reforma agrária e a agricultura familiar no Brasil. Santiago Chile, 2001.
3. Bittencourt G. Agricultura familiar e agronegócio: questões para pesquisa. In: Lima, Dalmo M. de Albuquerque; Wilkinson, John (Orgs.). Inovações das tradições da agricultura familiar. Brasília: CNPq, 2002.
4. Abramovay R. Paradigmas do Capitalismo Agrário em questão. São Paulo. Anpocs, Unicamp, Hucitec, 1992. “Uma nova extensão para a agricultura familiar”. In: Seminário Nacional De Assistência Técnica e Extensão Rural. Brasília, DF, Anais, 1997, p. 29 (Texto para discussão).
5. Lamarche H. A agricultura familiar: uma realidade multiforme. Campinas: Editora da Unicamp, 1993. A análise da empresa familiar agrícola ou industrial. In: Association des Ruralistes Français. Lê monde Rural et lês Sciences Sociales: omission ou fascination. Tradução de Auro Luiz da Silva. Paris, 1994 a. XIX. Colóquio da Association des Ruralistes Françaises.
6. Abramovay R. Transformações na Vida Camponesa: o Sudoeste Paranaense, São Paulo: USP, 1981.
7. Hecht SA. evolução do pensamento agroecológico. In: ALTIERI, M. Agroecologia: as bases científicas da agricultura alternativa. 4. ed. Rio de Janeiro: PTA/FASE, 2000.

8. Wanderley MNB. O Campesinato Brasileiro: uma história de resistência. Disponível em: <http://www.scielo.br/pdf/resr/v52s1/a02v52s1.pdf>. Acesso em 14/10/2019.
9. BRASIL. Presidência da República. Casa Civil. Lei nº 11.326, de 24 de julho de 2006. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/111326.htm. Acesso em 24/08/2019.
10. BRASIL. Decreto nº 1.946, de 28 de junho de 1996. Cria o programa nacional de fortalecimento da agricultura familiar (PRONAF), e dá outras providências. Diário Oficial da União, Brasília, DF, 1 julho 1996.
11. Mattei L. Programa nacional de fortalecimento da agricultura familiar (PRONAF). Brasília: Ministério do Planejamento, 2005.
12. BRASIL. Constituição Federal. Presidência da República. Brasil. Brasília-DF. Disponível em: <http://www.planalto.gov.br/ccivil>. Acesso em 24/08/2019.
13. Elkington J. Triple bottom line revolution: reporting for the third millennium. Australian CPA, v. 69, p. 75, 1994.
14. Batalha MO. Gestão Agroindustrial. 2. ed. São Paulo: Atlas, 2001.
15. Teixeira EC. Desenvolvimento agrícola na década de 90 e no século XXI. Viçosa: Finep/Fapemig, 1993.
16. Pedroso MTC. Agricultura Familiar Sustentável: Conceitos, experiências e lições. 111f. Dissertação (Mestrado em Desenvolvimento Sustentável) Centro de Desenvolvimento Sustentável, Universidade de Brasília, Brasil, 2000.
17. Anjos O. Agricultura familiar como fator chave no desenvolvimento rural sustentável: um estudo no assentamento Joana Darc III em Rondônia. (Dissertação). Mestrado em Gestão Ambiental, Universidad San Carlos, Asunción (Paraguay), 2019.
18. Damasceno NP, Khan AS, Lima PVPS. O impacto do Pronaf sobre a sustentabilidade da agricultura familiar, geração de emprego e renda no Estado do Ceará. Rev. Econ. Sociol. rural vol.49 no.1 Brasília Jan./Mar. 2011. Disponível em: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-20032011000100006. Acesso em 10.11.2019

19. Sousa MC, Passos ANTB, Khan AS. Qualidade de vida da agricultura familiar em assentamentos da reforma agrária no Rio Grande do Norte. Congresso Brasileiro de Economia e Sociologia Rural, SOBER, 42, 2004.
20. Gil AC. Como Elaborar Projetos de Pesquisa. São Paulo: Atlas, 2008.
21. Lakatos EM, Marconi MA. Fundamentos de Metodologia Científica. 5ª ed. São Paulo: Atlas, 2003.
22. Silva EL, Menezes EM. Metodologia da Pesquisa e Elaboração de Dissertação. 3ª ed. revisada e atualizada. UFSC/PPGEP/LED. Florianópolis, 2001.
23. Matias-Pereira J. Manual de Metodologia de Pesquisa Científica. 2. ed. São Paulo: Atlas, 2010.
24. Bruyne P, Herman J, Schiutheete M. Dinâmica da Pesquisa em Ciências Sociais. Rio de Janeiro: Francisco Alves, 1977.
25. Yin RK. Estudo de caso: planejamento e métodos. 3 eds. Porto Alegre: Bookman, 2005.
26. Barbetta PA. Estatística aplicada às Ciências Sociais. 1. ed. Florianópolis: UFSC, 1994.
27. Toledo GL, Ovalle II. Estatística Básica. 2. ed. São Paulo: Atlas, 2010.
28. Kazmier LJ. Estatística aplicada a economia e administração. Porto Alegre: Bookman, 2008.
29. Bezerra GJ, Schlindwein MM. Family Farming as income generation and local development: an analysis in Dourados, MS, Brazil. INTERAÇÕES, Campo Grande, MS, v. 18, n. 1, p. 3-15, jan./mar. 2017.
30. Francisco WC. Reforma Agrária; Brasil Escola. Disponível em <<https://brasilecola.uol.com.br/sociologia/reforma-agraria.htm>>. Acesso em 17.12.2019.
31. Sangalli AR. Assentamento Lagoa Grande, em Dourados, MS: aspectos socioeconômicos, limitações e potencialidades para o seu desenvolvimento. 2013. 107 p. Dissertação (Mestrado em Agronegócios) - Universidade Federal da Grande Dourados, Dourados, MS, 2013.
32. INCRA. Instituto Nacional de Colonização e Reforma Agrária (INCRA). Projetos de reforma agrária conforme fases de implementação. 2015. Disponível em: <http://www.incra.gov.br/sites/default/files/uploads/reforma-agraria/questao-agraria/reforma-agraria/projetos_criados-geral.pdf>. Acesso em: 12 Nov. 2019.

33. Souza PM, Fornazier A, Ponciano NJ, Ney MG. Agricultura familiar versus agricultura não-familiar: uma análise das diferenças nos financiamentos concedidos no período de 1999 a 2009. Documentos Técnico- Científicos, v. 42, n. 1, jan./mar. 2011.
34. De Paula MM, Kamimura QP, Silva JLG. Mercados institucionais na agricultura familiar: dificuldades e desafios. Revista de Política Agrícola, n. 1, p. 33-43, 2014.
35. Roos D. Lutas Camponesas e Diferentes Atividades Associativas nos Assentamentos de Sem-Terra. Revista NERA. Presidente Prudente Ano 12, nº. 14 pp. 97-111 Jan.-jun./2009. Disponível em: http://www2.fct.unesp.br/nera/revistas/14/11_roos.pdf. Acesso em: 17.12.2019.
36. Almeida RA, Kudlavicz M. A potencialidade da pequena unidade de produção em Mato Grosso do Sul: os censos agropecuários 1995/96 e 2006 em debate. In: Faistig AL, Faria MFL. de (Org.). Direitos humanos, diversidade e movimentos sociais: um diálogo necessário. Dourados, MS: Ed. UFGD, 2011. p. 45-66.
37. EMBRAPA. Sistema de consórcio com mandioca. Disponível em: <https://www.embrapa.br/busca-de-solucoes-tecnologicas/-/produto-servico/2112/sistema-de-consorcio-com-mandioca>. Acesso em: 17.12.2019.
38. Fancelli AL. Pesquisas certificam espécies para rotação de culturas. Revista Visão Agrícola, n. 9, p. 17-20, 2009.
39. Arnhold MF, Ritter AFS, Balbinot M. Benefícios do sistema de rotação de culturas. In: 3ª Simpósio de Agronomia e Tecnologia em Alimentos, p. 1-5, 2016.
40. Coelho CN. A expansão e o potencial do mercado mundial de produtos orgânicos. Revista de Política Agrícola, ano 10, n. 2, p. 9-26, 2001.
41. Alvarenga AC, Fernandes LA, Campos PCO. Avaliação de sistemas agroflorestais com base em indicadores de sustentabilidade de determinação rápida e fácil. Caderno de Agroecologia. Vol 6, Nº 2, Dez 2011.
42. Mendes JTG, Padilha Junior JB. Agronegócio: uma abordagem econômica. São Paulo: Pearson Prentice Hall, 2007.
43. Waquil PD. Mercados e comercialização de produtos agrícolas / Paulo Dabdab Waquil, Marcelo Miele [e] Glauco Schultz; coordenado pela Universidade Aberta do Brasil – UAB/UFRGS e pelo Curso de Graduação Tecnológica – Planejamento e Gestão para o Desenvolvimento Rural da SEAD/UFRGS. – Porto Alegre: Editora da UFRGS, 2010.

44. Cristopher M. Logística e Gerenciamento da Cadeia de Suprimentos - Estratégias para Redução de Custos e Melhoria dos Serviços, 1ª ed. São Paulo, Editora Pioneira, 1997.
45. Ballou RH. Logística Empresarial: Transportes, administração de materiais e distribuição física. São Paulo: Atlas, 2011.
46. BRASIL. Governo do Brasil. Agricultura familiar brasileira é a 8ª maior produtora de alimentos do mundo. Disponível em: <http://www.brasil.gov.br/editoria/economia-e-financas/2018/06/agricultura-familiar-brasileira-e-a-8a-maior-produtora-de-alimentos-do-mundo>. Acesso em 10/10/2019.
47. BRASIL. BNDES. Requisitos para enquadramento no Pronaf. Disponível em: <https://www.bndes.gov.br/wps/portal/site/home/financiamento/produto/pronaf-requisitos/>. Acesso em: 24/09/2019.
48. Andrade M et al. Coletivização: uma proposta para os camponeses: primeiras indagações acerca das ações do Estado na fixação e organização das famílias trabalhadoras rurais para fins de reforma agrária. Versão Preliminar. São Paulo: Pro-ter/CEDI, 1989.
49. Melo VA. Introdução ao Lazer. Barueri SP: Manole, 2003.
50. França ACL. Qualidade de vida no trabalho: conceitos e práticas nas empresas da sociedade pós-industrial. 2003. Biblioteca Virtual em Saúde (BVS). Acesso em 09.12.2019.
51. Farshad A, Zink JA. Assessing agricultural sustainability using the six-pillar model: Iran as a case study. In: Gliessman SR. Agroecosystem sustainability: developing practical strategies. Boca Raton, Florida: CRC Press, 2001. p.137-151.
52. Altieri M. Agroecologia: a dinâmica produtiva da agricultura sustentável. Porto Alegre: Ed. Universidade/UFRGS, 2004. 110 p.
53. Brandenburg A. Agricultura familiar, ONGs e desenvolvimento sustentável. Curitiba: ed. da UFPR. 1999.
54. Veiga JE. Problemas da transição à agricultura sustentável. In: Veiga JE. Agricultura Sustentável, São Paulo: IPE/USP, v. 24, p. 5-29, 1994. (Coleção Estudos Econômicos).
55. Carmo MS do. A produção familiar como locus ideal da agricultura sustentável. Agricultura em São Paulo, UNESP-SP, 45(1):1-16, 1998.

Mobile application proposal for mapping of multi-drug resistant bacteria information management: A study applied in a Brazilian city

Marcio Rodrigo Santos

Setor de Ciências Sociais Aplicadas, Universidade Federal do Paraná - UFPR, Curitiba, Brasil.

Lucas José de Souza

Setor de Ciências Sociais Aplicadas, Universidade Federal do Paraná - UFPR, Curitiba, Brasil.

Egon Walter Wildauer

Setor de Ciências Sociais Aplicadas, Universidade Federal do Paraná - UFPR, Curitiba, Brasil.

Suelen Balero de Paula-Petroli

Centro de Ciências da Saúde (CCS), Universidade Estadual de Londrina - UEL, Londrina, Brasil.

Floristher Elaine Carrar-Marroni

Centro de Ciências da Saúde (CCS), Universidade Estadual de Londrina - UEL, Londrina, Brasil.

Abstract

The mapping and identification of multi-drug resistant (MDR) bacteria in effluents and effluents requires updated data on their reality and context. However, the process of analyzing these results is still slow and sometimes ineffective due to the lack of adequate technological mechanisms. This article presents the development of a mobile application as a tool for the information management system using geolocation and dashboards to map collection points, as well as resources to analyze the results obtained. The M.I.T. APP Inventor was used in the project along with PHP PDO and MySQL technology in the web server layer. The preliminary results indicated an interesting alternative solution to the specialists' requirements to contribute to management and decision-making, as well as a useful tool for interested health agents.

Keywords: App Inventor; Information Management; Mobile Application; Multi-drug resistant bacteria;

1. INTRODUCTION

Currently, antimicrobial resistance (AMR) is considered a public health problem worldwide, responsible for difficult-to-treat infections associated with high mortality rates and high health care costs[1]. The increase in AMR in clinically important bacteria is associated with the extensive or inappropriate use of antimicrobials in human and veterinary medicine, in agriculture and livestock. Although the consequences are clinical, studies have proposed that the spread of AMR is not restricted to health facilities, since antimicrobial resistant bacteria have been found in effluents and sewage treatment plants (STP) [2]

[3] [4].

Effluents and STP have been proposed as important reservoirs of multi-drug resistant bacteria and antimicrobial resistance genes (ARGs) are considered pollutants emerging from the environment. These aquatic environments act as critical points for the horizontal transfer of ARGs, since their high bacterial load and compounds that include antibiotics, heavy metals and biocides, which even in low concentrations, exert selective pressure on the antimicrobial resistance, allow an even wider spread of ARGs between environmental bacteria and human pathogens [2] [5] [6].

Hospital effluents, in particular, may have different ARGs profiles when compared to other aquatic environments, due to different patterns of use and frequency of antimicrobials [5]. These effluents are made up of human excrement and therefore reflect bacteria resistant to antimicrobials and the original ARGs from clinical sources [7]. Bacteria and genes reach the effluents and the remnant of the processing in the STP can contaminate rivers and lakes, constituting an AMR reservoir at constant risk to the health of humans and animals [8].

The concept of "one health" or "a single health" gained notoriety due to the concern to combat AMR in all affected environments and sectors, such as human and veterinary medicine, agriculture, environment, economy, among others [6]. The most recent Global Action Plan on AMR developed by World Health Organization (WHO) was published in 2015 and, based on the concept of One Health, establishes five objectives for the control and prevention of AMR, among which we highlight: Increase awareness of how AMR is developed in different environments through the characterization of new resistance mechanisms; and to monitor the incidence and prevalence of the main microorganisms, in order to establish surveillance and research programs and have greater support and investments from governmental organizations, industries and health agencies [9]. Based on this objective, we seek to employ Wastewater-Based Epidemiology, a new epidemiological tool with the potential to act as a complementary approach to current infectious disease surveillance systems and as an early warning system for disease outbreaks, that is, by going beyond the laboratory and hospital data [10].

Thus, the objective of the research is to propose a mobile application that supports the management of information on the theme of antibiotic resistance of microorganisms found in treatment plants, rivers and lakes. The application concatenates georeferenced data from the collection points with the quantitative results of the microbiological tests of the collected samples and provides the information allowing the monitoring and decision making based on reliable information and in real time. The study is been running in the city of Londrina - Brazil in a partnership between the researchers and the Department of Pathology, Clinical and Toxicological Analysis, Health Sciences Center, of Universidade Estadual de Londrina (UEL), the local public university, which facilitated the implementation of the application and the collection of samples in strategic points of the city.

2. INFORMATION MANAGEMENT

Information Management (GI) is characterized by [15] [16] [17] as a cycle of related processes capable of transforming data into information that contribute to decision making and the creation of new knowledge. The information management ecosystem can be defined as:

- i) **Identify information needs:** Firstly, the need for information is recognized, it presupposes a clear understanding of the area of operation of the organization and its main competitors made through a mapping of the sources of information relevant to the context [17]
- ii) **Acquisition of information:** According to [18], information acquisition comes from information needs. [17] explains that the acquisition of information must combine two approaches, automated and human exploration.
- iii) **Organization and storage of information:** [18] states that they are two main purposes: to find sources of experience and to retrieve reports of previous work or similar problems. For [15] classification and storage presuppose the determination of how users select and access information from the chosen repository to store it
- iv) **Dissemination of information (Communication):** The information is distributed according to the needs indicated by each user. [19] believes that the better the organizational communication, the more optimized the distribution of information to its user. In the model proposed by [18], the distribution and sharing of information are necessary conditions for perception and interpretation
- v) **Use of information:** For [19], this is the most important stage of the entire Information Management process. The use of information and its combinations allows the emergence of new knowledge, which can feed the corporate information cycle, in a continuous process of learning and growth. Presents three ways of using information: creating meaning, building knowledge and making decisions [18].

Another aspect that is within the information management cycle is the area of information visualization, which condenses aspects of computer graphics, human-computer interaction, cartography and data mining, in order to combine them, transforming data into images or graphics [20]. It can be divided into two main aspects: the structural modeling, which aims to detect, extract and simplify information hidden in the data and the graphic representation of the structural modeling performed [21]. The techniques related to the visualization of information seek to represent, through graphic elements, the information contained in a determined domain of application, so that these elements can bring to the human being the correct interpretation and understanding to deduce new knowledge [22].

3. MATERIALS AND METHOD

The nature of the research is applied, as it intends to generate knowledge for the solution of a given problem, with a descriptive objective, as it allows the description of a certain phenomenon, in this case, informational modeling for the monitoring of MDR bacteria at collection points of the city of Londrina - Brazil.

The App Inventor tool was used to develop the application, maintained by the Massachusetts Institute of Technology (MIT), which allows the creation of applications for smartphones and tablets using the Android operating system. The database used to persist the collected data was MySQL and, in the service layer, the PHP PDO language was used to persist the data through HTTP requests in the MySQL

relational database.

To implement the geolocation functionality, OpenStreetMap, which provides the manipulation of points on the map and the delimitation of regions. A meteorological system was also integrated through a web service that, based on the current GPS coordinates, informs the region's temperature when collecting samples.

The modeling of the application started with the delimitation of its scope, followed by the definition of the users' profile, so that the system modeling process was being adapted in relation to its usability, so that the application could make the entire information management cycle available to facilitate monitoring and decision making.

4. Results and Discussion

The application is simple and intuitive, a map is displayed on the front end to locate the markers placed where the collection is carried out, and to allow data update and the visualization of the sample collection points by geolocation. It is possible to define the date / time, the description of the collection and the type of place where the water sample is being extracted (Affluents and Effluents). A second registration step occurs later, the laboratory analysis of the samples. It is possible to record the genes detected in the samples and the results of the isolates recovered, where the cultured bacteria are identified at the level of gender and species and subjected to antimicrobial susceptibility tests (AST). New data can be entered by multiple users at the same time, and the data is updated between them. Finally, there is the data visualization route, which, through interactive panels, allows monitoring the data collected and analyzed in real time. The application's functionalities are summarized in Table 1, with their respective descriptions:

Table 1 – Features and Description of Mobile Application

Feature	Description
(1) Registration of the collection point by geolocation	Register user information at the sample (wastewater and surface water) collection point. (Location via GPS, Date and Time of collection, Weather at the time of collection, Brief description of collection)
(2) Registration of genes detected in the samples	When the sample is collected and analyzed in the laboratory, it is possible to register the genes found in the wastewater and surface water. From the mapped genes, it is possible to add which antibiotic the pool of bacteria in the sample are resistant to, creating a catalog of antimicrobial resistance.
(3) Isolates Recovered data registration	In addition to the quantification of antimicrobial resistance encoding genes directly from wastewater and surface water (2), the collected samples are seed in specific culture mediums. Cultivated bacteria are identified at the level of genus and species and undergo AST. Resistance determinants are detected and the isolates are subjected to molecular typing tests. With this, it is possible to describe and map bacterial species, elucidate their sensitivity profiles, their arsenal of antimicrobial resistance encoding genes and the presence of clones, including epidemic clones called high-

	risk clones. We also seek to establish a possible route of dissemination and/or contamination of important bacterial species in the hospital environment to the environment.
(4) Data visualization	The system information is saved in a relational database (MySQL) and the system allows selecting (SELECT) registered data in order to generate interactive and dynamic graphs that can be manipulated in order to allow the management of information, generating knowledge and contributing decision making.

Source: Authors

The application is in prototyping and Figure 1 shows the navigation screens, being (a) points registered via geolocation; (b) dashboard graphs generated after analyzing and registering the data of the samples collected:



Figure 1. application screens

The information architecture is represented in Figure 2 by means of a diagram, which contemplates the information management cycle and the steps that the application meets:

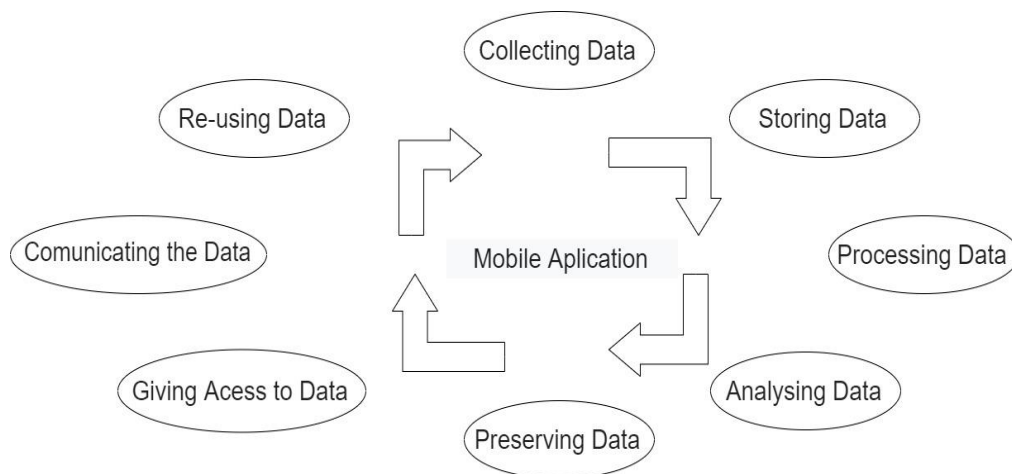


Figure 2. App information management cycle. Adapted and adjusted from McGee and Prusak (1993) and Davenport (1998).

The life cycle of the application is summarized in eight stages, being the collection of wastewater and surface water samples, the recording of data by geolocation at the time of collection. After the samples are processed and analyzed in the laboratory, the data are preserved and indexed in order to allow those interested in accessing the data, either for quantitative analysis or for internal consultations for correction or changes in the results obtained.

Finally, the data is communicated and made available for viewing through an interactive dashboard that generates consultation reports in real time. At the end of the life cycle, the data can be reused or stored for future reference to support predictive and temporal mathematical models of the data.

5. Conclusion

Wastewater-Based Epidemiology (WBE) is a new surveillance technique that has potential to act as a complementary approach for current infectious disease surveillance systems. The analysis of antimicrobial resistance genes together with bacterial monitoring could give a more representative reflection of health of a community, understanding of disease and resistance circulating within a population. The ability to rapidly monitor the spread of MDR bacteria and resistance encoding genes, in real time, based in the analysis of wastewater and surface water, in well-defined geographical areas, could act as a key that providing information for prevention, intervention and control of MDR infections outbreaks.

Through the prototyping of a mobile application, this article proposes an information management model to support from the structured data collection, the organization, treatment and availability of data so that it is possible to consolidate a database on MDR bacteria, resistance determinants and the their dissemination routes in aquatic environments with potential hazards for a population.

The case study conducted in the city of Londrina in a partnership between researchers from UEL and UFPR point out in preliminary results the satisfaction of users with the usability and the ecosystem in which the data are transformed into information.

Dashboards allow a broader analytical view and with the potential to expand with other data sources. In general, it is expected that the mobile application can still be complemented with quantitative models allowing the expansion of data sources and the amount of data collected, in order to expand the reach and use of the application.

7. References

- [1] OPA (2017) Folha Informativa – Resistência aos Antibióticos. Disponível em:<www.paho.org/bra/index.php?option=com_content&view=article&id=5664:folha-informativa-resistencia-aos-antibioticos&Itemid=812>
- [2] Turano, H., Gomes, F., Medeiros, M., Oliveira, S., Fontes, L. C., Sato, M. I., & Lincopan, N. (2016). Presence of high-risk clones of OXA-23-producing *Acinetobacter baumannii* (ST79) and SPM-1-producing *Pseudomonas aeruginosa* (ST277) in environmental water samples in Brazil. *Diagnostic microbiology and infectious disease*, 86(1), 80-82.
- [3] Karkman, A., Do, T. T., Walsh, F., & Virta, M. P. (2018). Antibiotic-resistance genes in waste water. *Trends in microbiology*, 26(3), 220-228.
- [4] Ory, J., Bricheux, G., Robin, F., Togola, A., Forestier, C., & Traore, O. (2019). Biofilms in hospital effluents as a potential crossroads for carbapenemase-encoding strains. *Science of the Total Environment*, 657, 7-15.
- [5] Wang, Q., Wang, P., & Yang, Q. (2018). Occurrence and diversity of antibiotic resistance in untreated hospital wastewater. *Science of the Total Environment*, 621, 990-999.
- [6] Fouz, N., Pangesti, K. N., Yasir, M., Al-Malki, A. L., Azhar, E. I., Hill-Cawthorne, G. A., & Ghany, M. A. E. (2020). The contribution of wastewater to the transmission of antimicrobial resistance in the environment: Implications of mass gathering settings. *Tropical medicine and infectious disease*, 5(1), 33.
- [7] Paulus, G. K., Hornstra, L. M., Alygizakis, N., Slobodnik, J., Thomaidis, N., & Medema, G. (2019). The impact of on-site hospital wastewater treatment on the downstream communal wastewater system in terms of antibiotics and antibiotic resistance genes. *International journal of hygiene and environmental health*, 222(4), 635-644.
- [8] Sakkas, H., Bozidis, P., Ilia, A., Mpekoulis, G., & Papadopoulou, C. (2019). Antimicrobial Resistance in Bacterial Pathogens and Detection of Carbapenemases in *Klebsiella pneumoniae* Isolates from Hospital Wastewater. *Antibiotics*, 8(3), 85.
- [9] World Health Organization. (2015). Global antimicrobial resistance surveillance system: manual for

early implementation. World Health Organization.

[10] Sims, N., & Kasprzyk-Hordern, B. (2020). Future perspectives of wastewater-based epidemiology: monitoring infectious disease spread and resistance to the community level. *Environment international*, 105689.

[11] World Health Organization. Report on Global Priority List of Antibiotic-Resistant Bacteria to Guide Research, Discovery, and Development of New Antibiotics. Available online: <https://www.who.int/medicines/publications/global-priority-list-antibiotic-resistant-bacteria/en/> (accessed on 26 June 2019).

[12] Frost, I., Van Boeckel, T. P., Pires, J., Craig, J., & Laxminarayan, R. (2019). Global geographic trends in antimicrobial resistance: the role of international travel. *Journal of travel medicine*, 26(8), taz036.

[13] Talon, D. (1999). The role of the hospital environment in the epidemiology of multi-resistant bacteria. *Journal of Hospital Infection*, 43(1), 13-17.

[14] Tarricone, R., Rognoni, C., Arnoldo, L., Mazzacane, S., & Caselli, E. (2020). A Probiotic-Based Sanitation System for the Reduction of Healthcare Associated Infections and Antimicrobial Resistances: A Budget Impact Analysis. *Pathogens*, 9(6), 502.

[15] Checkland, P., & Holwell, S. (2006). Data, capta, information and knowledge. *Introducing information management: The business approach*. London: Elsevier, 47-55.

[16] McGEE, J. V., & Prusak, L. (2004). *Gerenciamento estratégico da informação*. Elsevier Brasil.

[17] DAVENPORT, T., & PRUSAK, L. (1998). *Conhecimento Empresarial*, Editora Campus, Rio de Janeiro, RJ.

[18] Choo, C. W. (2003). *A organização do conhecimento: como as organizações usam a informação para criar significado, construir conhecimento e tomar decisões*. São Paulo, Brazil: Senac São Paulo.

[19] BEAL, A. (2004). *Gestão estratégica da informação: como transformar a informação em fatores de crescimento e de alto desempenho nas organizações*. São Paulo: Atlas.

[20] Correa, R. F., & Vieira, J. M. D. L. (2013). Representações visuais para recuperação de informação na BDTD-UFPE. *Perspectivas em Ciência da Informação*, 18(4), 18-34.

[21] Chen, C. (2004). *Information visualization: Beyond the horizon*. Springer Science & Business Media.

[22] Freitas, C. M. D. S., Chubachi, O. M., Luzzardi, P. R. G., & Cava, R. A. (2001). Introdução à visualização de informações. Revista de informática teórica e aplicada. Porto Alegre. Vol. 8, n. 2 (out. 2001), p. 143-158.

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/>).

Aspects Related to Nurse Leadership in Several Places of Action:

Literature Review

Antonny Michael da Silva Sousa; Mikaelly Pinheiro Garcia; Eveline Menezes Caçote Barbosa; Loren Rebeca Anselmo do Nascimento; Rayner Augusto Libório dos Santos Monteiro; Graciana de Sousa Lopes

Abstract

It is an integrative review in order to analyze aspects related to the leadership of nurses in the last ten years. The search was carried out from July to August 2019 in Portuguese, English and Spanish. LILACS, BDENF and SCIELO were used as database. For the selection of articles, the descriptors "Perception", "Leadership" and "Nursing" were combined, of which 46 met the inclusion and exclusion criteria, which were analyzed using a Preferred Reporting Items for Systematic Review and Meta-Analyses checklist - PRISM. As a result, 23 articles were included for the discussion of the theme from four categories: Perception about Leadership, Challenges faced; Communication in interpersonal relationships and Professional qualification. It is noticed that, still, the need to reflect on the work process of nurses so that they have the necessary conditions to deepen their scientific research, developing safe and quality care and a management committed to professional and social valorization.

Keywords: Perception; Leadership; Nursing; Health Services Administration; Nursing Research.

1. INTRODUCTION

Leadership consists of the art of influencing people through ideas and actions, being an essential tool for the nurse's work process that can be innate to certain people or acquired during academic training (BALDONADO, SANTOS, 2015).

It is linked to different human organizations, when an individual seeks to influence the behavior of another in relation to activities within an institution. (CARDOSO, RAMOS, D'INNOCENZO, 2014). Therefore, the leader needs to know human nature and know how to lead people, in addition to planning and coordinating activities related to the professional environment (OLIVEIRA, MISUE, PAGLIARINI, 2011). Currently, in addition to the technical competence and scientific knowledge acquired by the nurse, the nursing team seeks to value a series of other characteristics referring to the good leader, among which are: communication, interpersonal relationships, decision making, teamwork team, as well as making it possible to readjust behaviors and actions that favor themselves and the multidisciplinary team, and they must be able to assume leadership positions, always bearing in mind the well-being of the community (CARRARA et al., 2017; AMESTOY et al., 2009; DIAS et al., 2017).

Among the types of leadership that exist according to the behavior of the leader, democratic leadership stands out, characterized by the group's participation in decision-making; permissive or laissez-faire, whose

leader adopts a passive posture and delegates control of the group to the team, with little interference in the work process and autocratic leadership, which consists of centered decision making by the leader without the participation of the other followers (FARAH, 2017).

Regarding contemporary theories, the following stand out: the situational, where the leader adapts to different leadership styles according to the situation to be solved, the transformational, the leader inspires his followers positively to achieve goals and objectives (FONSECA, PORTO, BORGES, 2015).

In this context, the performance of this professional during management in the work process transcends a relationship of authority to the other members of the team. This is due to the way little understood as being a complementary dimension during the assistance provided to the client towards the management of care (REIS, 2019; SANTOS et al., 2019; CHRISTOVAM, 2012).

Considering the importance of the role of the nurse leader in the nursing team, the question is: how many scientific productions address the role of leadership in nursing in the last 10 years? Thus, it is proposed as a general objective to analyze aspects related to the leadership of nurses in the last ten years.

2. METHODOLOGY

The study consists of an integrative literature review - (RIL) which makes it possible to analyze the findings of different researches on a given subject and points out gaps in the knowledge that need to be filled with the realization of new studies, based on systematic and strict steps. (SOARES et al., 2014; SOUZA, SILVA, CARVALHO, 2010).

Then, we elaborated guiding question: how many scientific productions do they address about the leadership of nurses in the last 10 years?

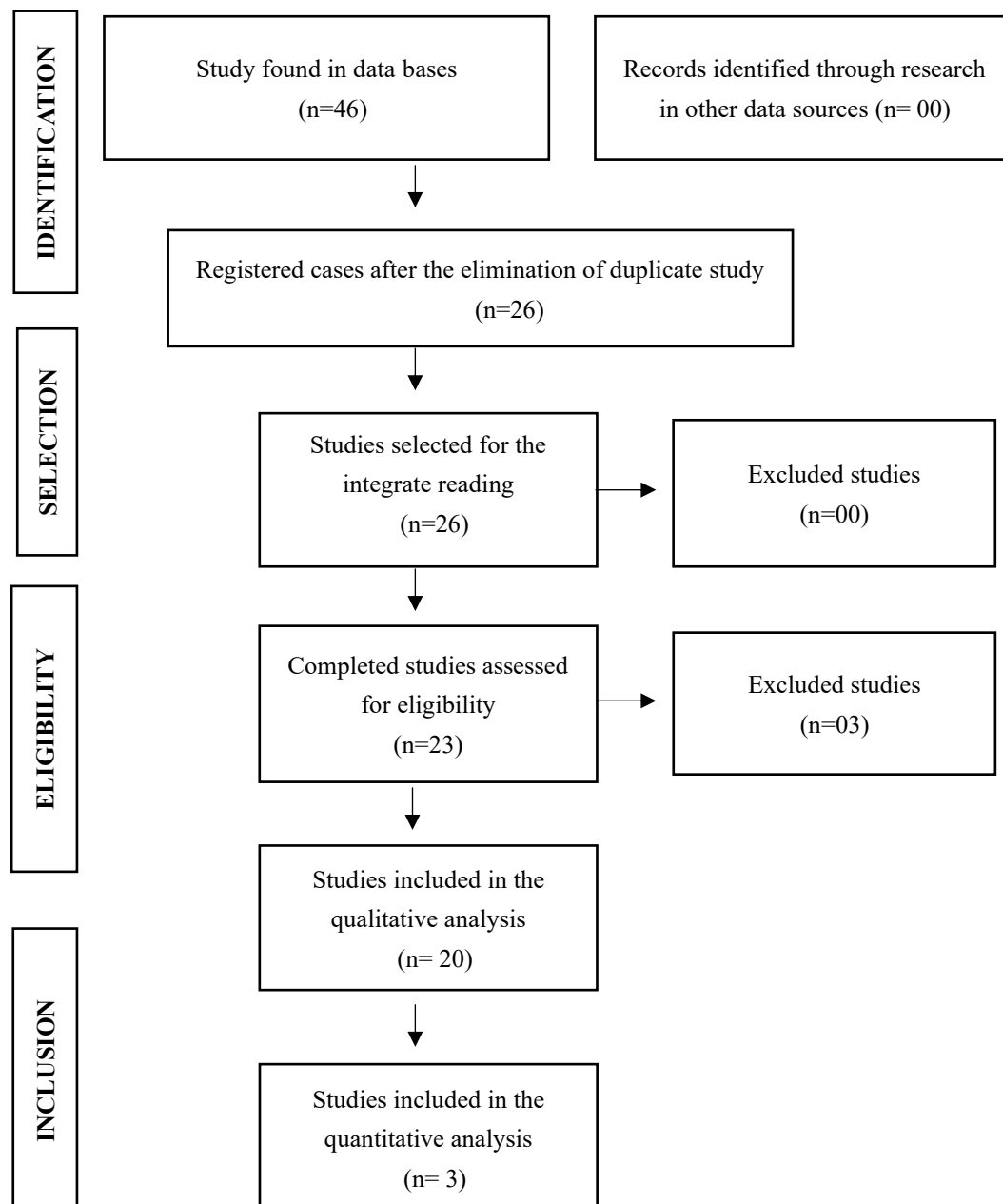
The descriptors chosen were "Perception", "Nursing", "Leadership", "Health Services Administration" and "Nursing Research" associated and carried out combinations with the Boolean operators "AND" and "OR". The investigation for the collection of data was in July until December of 2018.

To search for the papers, were used the databases of Latin American and Caribbean Literature in Health Sciences (LILACS), Nursing Database (BDENF) and the Virtual Scientific Electronic Library Online (SciELO). The choices of the sources were intentional in order to identify scientific productions that were in accordance with the proposed theme and within the inclusion criteria.

Regarding the eligibility criteria, complete articles were selected and available in the databases that corresponded to the proposed objective according to the descriptors, free articles, in Portuguese, English and Spanish with publication date between the years 2008 to 2018 carried out in Brazil. The criteria for ineligibility were abstracts, theses, dissertations, works published in annals of events and literature reviews. Regarding the selections of the articles, the Preferred Reporting Items for Systematic Review and Meta-Analyses - PRISMA (2015) flowchart was used, containing four steps: identification of the studies found in the databases, selection through the thorough reading of the titles and abstracts, eligibility of the articles selected in the previous step in which it was analyzed in general to identify the studies that would be added and the inclusion that is the final stage of the process with the number of studies included in the research. About the analysis of the data, the checklist instrument PRISMA was used, which contains 27 items of information extraction which allowed to have a critical evaluation of the scientific productions.

A critical analysis of the selected articles is described through an exhaustive reading, filling in the instrument, organization of the studies regarding the hierarchical level of evidence, presentation of the results by discussing the findings in the literature in order to respond to the object of study (GALVÃO, 2006).

During the database search, forty-six articles were found in the databases. Of these, twenty articles were excluded for not meeting the eligibility criteria, resulting in twenty-six articles, as shown in the figure below adapted to the PRISMA model.



3. RESULTS AND DISCUSSION

There were included in this review 23 articles that attended the eligibility criteria, 17 in Portuguese, 06 in English and 02 in Spanish, as for the database, selected from LILACS (13), SCIELO (04) and BDENF (08).

Although the search for this review covered the period from 2008 to 2018, the selected articles fall within the period from 2009 to 2018.

About the level of evidence, III- pilot study of the quasi-experimental type and IV- correlational study were classified, with a greater predominance of qualitative articles, at the level of evidence V (GALVÃO, 2006). As for the publication period, all 46 initial articles appeared in the LILACS, SCIELO and BDENF databases as of 2008. After analyzing the data, it obtained as a final sample (2) articles published in 2018, (5) in 2017, (6) in 2016, (2) in 2015, (1) in 2014, (92) in 2013, (1) in 2011, (2) in 2009.

The results were grouped into four thematic categories: Perception about Leadership; Challenges faced; Communication in interpersonal relationships and Professional qualification.

Table 1: Bibliographical search

Authors/ Year	Databases	Outline / Level of Evidence	Synthesis of Results
Camargo FC et al., 2017	LILACS	Pilot study Almost Experimental / III	The development of new research that includes Evidence-Based Practice in units headed by nursing leaders is encouraged.
Balsanelli AP, David DR, Ferrari TG, 2018	SCIELO	Correlational Qualitative / IV	It was dechated in greater predominance as being the ideal leadership style for nurses, those who seek only to preserve their job and their interest in the service and in the team members is irrelevant.
Knop ALK, Gama BMBM, Sanhudo NF, 2017	LILACS	Qualitative / V	It was identified as challenges in the development of leadership: the participation of the team and the interpersonal relationship of the group.
Rigobello JL et al., 2018	LILACS	Qualitative / V	The internship is an environment conducive to learning the profession and developing managerial skills, however.
Souza LPS et al., 2015	LILACS	Qualitative, descriptive/ V	It was detached the need to reformulate academic training, in addition to building strategies for integrating students into the world of work, anticipating what they will find and how they should act in the face of this transition.
Amestoy SC., 2013	LILACS	Qualitative / V	It became relevant to rethink the teaching-learning process of leadership, in order to contribute to the development of this professional competence.

Souza RB, Ilha S, Lima CLF et al., 2013	LILACS	Qualitative / V	It was detached he need for professional preparation with regard to leadership skills, so that administrative and managerial nursing actions are viewed in a natural and encouraging way.
Costa DG, Dall'Agnol CM, 2011	LILACS	Qualitative / V	The involvement of nursing professionals in issues related to teamwork and group dynamics is an important condition to revitalize the participatory perspective of the leadership process.
Dalcól C, Garanhani ML, 2016	LILACS	Qualitative / V	Others studies pointed that explore the images and perceptions of nurses in relation to the weaknesses in the unit's management process, the challenges of teamwork and the needs of continuing education.
Barreto MS et al., 2015	LILACS	Qualitative / V	The relevance of nurses' assistance in emergency situations is perceived by the team, but the perceptions about their role as manager are still conflicting.
Walter RR, Gehlen MH, Ilha S et al., 2016	LILACS	Qualitative / V	The importance of a qualified team for the implementation of the Standard Operating Procedure is evidenced, by means of protocols within the units, thus reducing existing problems regarding patient care, prioritizing the quality of care.
Cardoso MLAP, Ramos LH, D'Innocenzo M, 2014	LILACS	Quantitative / Qualitative V	It was pointed out that communication is an essential competence in the leadership process for nurses. The QUAPEEL and QUEPTAELL instruments can be inserted in hospitals as strategies for mapping the nurse-leader and to identify the effects of adopting practices that influence the coaching process.
Amestoy SC, et al., 2009	SCIELO	Qualitative / V	It was noticed that there are still great difficulties in understanding the meaning of leadership, mainly to put it into practice.
Soares MI., 2016	SCIELO	Qualitative / V	It was revealed the need for teaching to be closer to practical problems is. Thus, the working institutions must review the skills of their professionals, implementing strategies to effectively achieve the excellence of the quality of care provided.
Jabur MRL, Dusso MS, Haro MC, 2009	BDENF	Quantitative and Qualitative / V	Difficulties in exercising leadership were identified: professional inexperience, interpersonal relationships with the team and authoritarianism. It is suggested to increase the workload and diversify the presentation of

			the content and that it is linked to clinical practice.
Leal LA, Camelo SHH, Santos FC, 2017	BDENF	Qualitative / V	Professors in the area must rethink their educational practice and training centers to reflect on the establishment of pedagogical strategies for improving the skills of their training body.
Vendruscolo C et al., 2016	BDENF	Qualitative / V	It was noticed that permanent education has been gradually incorporated into the work of professionals, especially in nursing, by recognizing their role in leading health management processes.
Dias AKG. et al., 2017	BDENF	Qualitative / V	It was noted that nurses do not clearly have knowledge about their managerial skills and role.
Farah BF et al., 2017	BDENF	Qualitative	Leadership was understood as: being at the head of the team; lead group of people; be an example; motivate and stimulate the team. Autocratic and democratic styles predominated in the study.
Braga DD et al., 2016	BDENF	Qualitative / V	I was emphasized is placed on a leadership linked to dialogue that helps in overcoming difficulties and enhancing this professional competence in the work environment.
Amestoy SC et al., 2016	BDENF	Qualitative / V	It was noticed that nurses have difficulties in leading and managing conflicts in the hospital environment. Studies that seek to encompass the team's professionals are recommended, in order to get to know their understanding of the nurse's leadership and broaden their views regarding the object studied.
Kian KO, Matsuda LM, Waidmann MAP, 2011	LILACS	Qualitative / VI	There were many factors related to the performance of the nurse leader: inexperience of the team, exhaustive work hours, working conditions, remuneration and personal characteristics of the nurse and the interference or not of the position in the quality of life.
Spagnuolo RS et al., 2012	LILACS	Qualitative / VI	Technical and scientific knowledge is detached as an important competence among others linked to relational practices.

3.1 Perception about Leadership

In the undergraduate course, a gap was noticed in academic education that would help the academic to exercise leadership and that the nursing course still focuses on technicality and biomedical models, leaving managerial knowledge to the background, which makes it difficult for the academic to develop leadership. (KNOP, 2017).

Other studies point to the exercise of developing the leadership skill in the supervised curricular internship

discipline, where it allows the student to have a view on the role of the nurse leader during the practice (AMESTOY, 2013). Thus, it is important that the preceptor nurse is trained, because when observing the attitudes and postures adopted by him, the trainee student relates theory and practice, especially in relation to leadership, which can help him understand how to lead a team (JABUR, DUSSO, HARO, 2009).

However, the challenge of this professional to perform it effectively persists. Many of them feel difficulties in exercising it due to lack of experience, which generates insecurity and consequently the resistance of employees to the acceptance of professional leadership, another factor that makes it difficult to know how to deal with different personalities within the same team (RIGOBELLO, 2018).

The nursing team understands that being a leader is to lead a team with responsibility, working in the collective and being ahead of the whole process, being a reference for the group members, however, another study points out that many still confuse it with the concept of management, and even authoritarian because they think that the leader only has some kind of influence on the followers as a result of their social position, position and title (AMESTOY et al., 2009; DIAS et al., 2017). Thus, by not understanding what leadership is, the professional ends up having difficulty in applying it.

According to Farah (2017), the ability to lead can be achieved and learned, but it is not an easy task, as it involves several aspects in the individual, relational and organizational spheres. For this reason, it is essential that nurses have a perception of leadership consistent with the concept in the literature, so that they can develop this skill and, thus, provide qualified and effective nursing care to the population.

3.2 Challenges Faced

It appears that the theme proposed in the study is little studied at graduation and for this reason the nurse in his first job ends up having difficulties in leading the team, especially when his colleagues have many years of experience at work. Thus, the newly graduated needs to face this challenge, that is, to lead a working group of the most experienced middle level and will only be able to obtain the necessary knowledge to manage nursing care and thus perform work with quality and safety (AMESTOY, 2016).

The professional needs to qualify, as many nurses during the research did not understand about the subject and that the work overload led to a lack of time for active search and critical analysis of scientific evidence, in addition to conditions of inadequate infrastructure, insufficient material, personnel, equipment and supplies; discouraged professionals, work overload and lack of training for the position of supervisor, which also hinders the development of skills and abilities to lead (SOUZA, 2013; FARAH, 2017).

In recent years, the managerial responsibility of nurses has been increasing, and with this a new challenge arises, how to coordinate the Family Health Strategy team, where the professional is faced with multiprofessionality in various social scenarios, that is, a team to which was not prepared, corroborating the difficulty in exercising this role (SOUZA, 2015).

Soares (2016), defends the idea that to perform the leadership, the professional needs to have new ideas, always be in dialogue with the team, understanding and knowing the needs of each person, seeking the resolution before passing on a problem situation.

3.3 Communication in interpersonal relationships

Based on the discussions of Soares (2016) and Jabur (2009), during the exercise of leadership, this

professional needs to perform skills and competences to improve interpersonal and interprofessional relationships in the work process, however, it is still a challenge for these professionals to place in practice this managerial knowledge due to the difficulties encountered in daily life, such as professional inexperience, authoritarianism and interpersonal relationships with team members. Thus, leadership, communication, teamwork and personal interaction need a different perspective by students, teachers and managers, since the teaching-learning process (KNOP, 2017; RIGOBELLO, 2018).

It is noteworthy that the leadership skill does not only cover criteria of techniques and management, but also factors that encompass characteristics personal, behavioral and interpersonal relationships, which are acquired from experiences (LEAL, 2017; BRAGA, 2016). Among them, there is an appreciation and the importance of dialogue in the relationships between professionals, in order to create bonds that enable the understanding and satisfaction of all (AMESTOY et al., 2009)

According to Carrara (2017), when a nurse is unable to establish a trusting relationship between his team, he may have difficulties to lead, as working in places where people are suspicious of each other prevents work from flowing at the normal pace. Thus, a good leader must establish an assertive communication with the other members of his team so that they have clarity in the message transmitted, in addition to establishing a relationship of trust during the work process (SOUZA et al., 2013).

3.4 Professional Qualification

According to Dias (2017), the globalization and the advancement of research, the search for knowledge and professional preparation become an inherent process in an individual's career. Therefore, the training of nurses in the management of their team brings the need for improvement even in undergraduate courses in order to establish a relationship between theory and the reality of the practice, since leadership is an inherent skill in this profession (BRAGA et al., 2016).

It was noted that there is still a lack of strategies that encourage interaction between the teacher and the student during the insertion of activities related to the internship (SOUZA et al., 2015). The relationship between the need for knowledge and professional development must be associated with training in the area of interpersonal communication, thus implying in their academic training and the profile of the future professional (BARRETO et al., 2015; FARAH et al., 2017).

In order to materialize any knowledge, it is necessary to always put it into practice and, for this, permanent education appears as an ally in this challenge, enabling the acquisition of knowledge about new technologies to the work process of nursing professionals, new tools for the patient care and positioning towards your team (SOARES et al., VENDRUSCOLO et al., 2016).

In a recent search, there was positive evidence regarding the reliability and applicability of the instruments used in the face of the coaching leadership process. Thus, coaching practice has proven to be an essential tool about the development of leadership skills, in addition to promoting behavioral and learning transformation, directly reflecting within organizations (CARDOSO et al., 2014).

4. CONCLUSION

Even though nurses understand that leadership is beneficial in their performance, there is still a difficulty

in developing it with their team members. Among the difficulties, the close interpersonal relationship with the team, authoritarianism and professional inexperience predominated. However, some tools that contribute to the exercise of leadership were identified: autonomy, teamwork, support from higher management and continuing education.

Thus, both professionals and the organization must be attentive to the quality of interpersonal relationships with other colleagues and their team, as their behavior and the way it is interpreted reflects the success or failure of quality care. In this sense, it is necessary that nurses have the ability to adapt to different scenarios of their performance, that is, adopting a style that is consistent with the reality portrayed in order to minimize personal conflicts.

It is also perceived the need to reflect on the work process of nurses so that they have the necessary conditions to deepen their scientific research, developing safe and quality care and management committed to professional and social valorization. It is hoped, therefore, that the study can contribute to new research aimed at leadership in nursing and promote a reflection by managers, teachers and students for personal and professional improvement.

Therefore, the importance of effectively teaching leadership since the period of the graduation is emphasized, with the development of scientific knowledge in the nursing care practices portrayed in several areas of activity.

7. References

Amestoy SC, Backes VMS, Thofehrn MB, Martini JG, Meirelles BHS, Trinity LL. Nurses' perception of the teaching-learning process of leadership. *Text Context Enferm.* [Internet]. 2013 Apr-Jun [access 2019 Aug 05]; 22 (2): 468-75.

Amestoy SC, Cestari ME, Thofehrn MB, Backes Vânia Marli Schubert, Milbrath Viviane Marten, Trindade Letícia de Lima. As percepções dos enfermeiros acerca da liderança. *Rev. Gaúcha Enferm.* [Internet]. 2009 Dec [cited 2019 Aug 05]; 30(4): 617-624.

Amestoy SC, Peixoto RS, Garcia RP, Santos BP, Silva CN, Braga DD. Perception of nurse leaders on conflict management in the hospital environment. *Rev Enferm UFSM* [Internet]. 2016 Apr/Jun. [access: 2019 Aug 05]; 6 (2): 259-269.

Brazil ÂS, Baldonado JC, Santos JA, Santos TA. LEADERSHIP: The art of influencing people. *AEMS Rev. Electronic Connection* [Internet]. 2015 [cited 2019 Jun 1] 12 (1): 1-15.

Braga DD, Amestoy SC, Echevarria ME, Savoia IC, Trinity LL. Nurse leadership exercise in the operating room. *J Nurs Health* [Internet]. 2016 [cited: 2019 Aug 05]; 6 (2): 267-78.

Balsanelli AP, David DR, Ferrari TG. Nurse leadership and its interface with the hospital work environment. *Acta paul. sick* [Internet]. 2018 Mar [cited 2019 Aug 05]; 31 (2): 187-193.

Barreto MS, Teston EF, Miranda JG, Arruda GO, Valsecchi EASS, Marcon SS. Perception of the nursing staff about the nurse's role in the emergency service. Rev Rene [Internet]. 2015 Nov/Dec [Access: 2019 Aug 05]; 16 (6): 833-41.

Camargo F, Pereira G, Iwamoto H, Lorraine L, Goulart M, Contim D. Workshops for the development of evidence-based practice among nursing leaders: a pilot study. REE [Internet]. 2017 Dec [cited Aug 05]; 190.

Cardoso MLAP, Ramos LH, D'Innocenzo Maria. Leadership coaching: Perception assessment questionnaires of leaders in nursing. Einstein [Internet]. 2014 Mar [cited 2019 Aug 05]; 12 (1): 66-74.

Carrara GLR, Bernardes A, Balsanelli AP, Camelo SHH, Gabriel CS, Zanetti ACB. A utilização de instrumentos para avaliação da liderança nos serviços de saúde e enfermagem. Rev Gaúcha Enferm [Internet]. 2017 June 38(3): e2016-0060._

Christovam BP. Nursing Care Management in hospital settings: construction of a concept. Rev. esc. Enferm USP [Internet]. 2012 June [cited 2019 Aug 12]; 46 (3): 734-741.

Costa DG, Dall'Agnol CM. Participative leadership in the management process of nightshift nursing. Rev. Latino-Am. Enfermagem [Internet]. 2011 Nov/Dez [cited 2019 Aug 05]; 19(6): 1306-1313.

Dalcol C, Garanhani ML. Managerial role of the operating room nurse: perceptions through images. Rev. Eletr. Nurse [Internet]. 2016 [cited: 2019 Aug 05]; 18: e1168.

Dias AKG, Toledo LV, Amaro MOF et al. The Perception of Nurses in relation to their managerial role in the hospital environment. J Nurs UFPE online [Internet]. 2017. May; 11 (Suppl. 5): 2185-94.

Farah BF, Dutra HS, Sanhudo NF, Costa LM. Percepção de enfermeiros supervisores sobre liderança na atenção primária. Rev Cuid [Internet]. 2017 Dec [cited 2019 Aug 05]; 8(2):1638-1655.

Fonseca AMO; Porto JB, Borges AJE. Leadership: A Portrait of Brazilian Scientific Production. Rev. adm. Contemp [Internet]. 2015 June [cited 2019 Aug 05]; 19(3):1415-6555.

Galvão CM. Editorial: Níveis de Evidência. Acta Paul Enferm [Internet]. 2006;19(2):V.

Jabur MRL, Dusso MS, Haro MC. Nursing Leadership: Undergraduate Learning. Nursing Care [Internet]. 2009 July/Dec [access: 2019 Aug 05]; 3 (2): 129-133.

Key Items to Report Systematic Reviews and Meta-analyzes: The PRISMA Recommendation. Epidemiol.

Serv. Health [Internet]. 2015 June [cited 2019 June 02]; 24 (2): 335-342.

Kian OK, Matsuda ML, Waidmann MAP. Compreendendo o Cotidiano Profissional do Enfermeiro-Líder. Rev Rene, Fortaleza [Internet] 2011 out/dez. [acesso em 2019 set 14] 12(4):724-31.

Knop ALK, Gama BMBM, Sanhudo NF. Nursing Students and Leadership Development: Challenges Facing in the Curriculum Internship. Revista de Enfermagem do Centro-Oeste Mineiro [Internet]. 2017 May; 7:e1204.

Leal LA, Camel SHH, Santos FC. The nursing administration teacher: Training and professional skills. J Nurs UFPE on line [Internet]. 2017 Jun [cited: 2019 Aug 05]; 11 (6): 2329-38.

Leal LA, Camel SHH, Santos FC. The nursing administration teacher: Training and professional skills. J Nurs UFPE on line [Internet]. 2017 Jun [cited: 2019 Aug 05]; 11 (6): 2329-38.

Mendes KDS, Silveira RCCP, Galvão CM. Integrative literature review: a research method to incorporate evidence in health care and nursing. Texto contexto-enferm [Internet]. 2008 Oct/Dec [cited 2019 Aug 07]; 17(4): 758-64.

Oliveira Kian, K, Misue Matsuda, L, Pagliarini Waidmann, MA. Compreendendo o cotidiano profissional do enfermeiro-líder. Rev Rene [Internet]. 2011 oct/dec; 12(4):724-31.

Reis GAX, Oliveira JLC, Ferreira AMD, Vituri DW, Marcon SS, Matsuda LM. Dificuldades para implantar estratégias de segurança do paciente: perspectivas de enfermeiros gestores. Rev Gaúcha Enferm. 2019;40(esp):e20180366.

Rigobello JL, Bernardes A, Moura AA, Zanetti ACB, Spiri WC, Gabriel CS. Supervised Curricular Internship and the development of management skills: a perception of graduates, undergraduates, and professor. Esc Anna Nery. [Internet]. 2018 Fev [Cited 2019 Fev 14]; 22(2):e20170298.

Santos JLG, Pestana AL, Guerrero P, Meirelles BSH, Erdmann AL. Nurses practices in nursing care management and health: integrative review. Rev. bras. Enferm [Internet]. 2013 Apr [cited 2019 June 02]; 66 (2): 257-263.

Soares CB, Hoga LAK, Peduzzi M, Sangaleti C, Yonekura T, Silva DRAD. Revisão Integrativa: Conceitos e métodos utilizados na enfermagem. Rev Esc. Enferm USP. [Internet]. 2014 [cited 2018 Jun 02]; 48(2):335-45.

Souza MT, Silva MD, Carvalho R. Integrative review: what is it? How to do it?. Einstein [Internet]. 2010 [cited 2018 Jun 02];8(1 Pt 1):102-6.

Souza RB, S Island, Lima CLF, et al. Organization and leadership in the work of nurses: Perception of nurses and nursing technicians. R. Enferm. Cent O. Min. [Internet]. 2013 May-August [access 2019 Aug 05]; 3 (2): 687-695.

Souza LPS, Silva WSS, Mota EC, Santana JMF; Santos LGS, Silva CSO, Barbosa DA. The challenges of the recent nursing graduate in the world of work. Cuban Nursing Rev [Internet]. 2015 [access 2019 Aug 05]; 30 (1): 4-18.

Soares MI, Camel SHH, Resck ZMR, Terra FS. Managerial knowledge of nurses in the hospital context. Rev Bras Enferm [Internet]. 2016 July/Aug [cited 2019 Aug 05]; 69 (4): 631-7.

Spagnuolo RS, Juliani CMCM, Spiri WC, Bocchi SCM, Martins STF. The nurse and the family health strategy: Challenges in coordinating the multiprofessional team. Health Care Cienc [Internet]. 2012 Apr/Jun [cited: 2019 Aug 05]; 11 (2): 226-234.

Vendruscolo C, Delazere JC, Zocche DAA, Kloh D. Continuing education as a potentiator of the management of the Brazilian health system: Perception of managers. Rev Enferm UFSM [Internet]. 2016 Apr/Jun [access: 2019 Aug 05]; 6 (1) 134-144.

Walter RR; Gehlen MH; Ilha S; et al. Standard operating procedure in the hospital context: the nurses' perception. J. res.: fundam. care. Online. [Internet]. 2016. Oct/Dec [cited 2019 Aug 05]; 8(4): 5095-5100.

Application of the Kalman Filter in Functional Magnetic Resonance Image Data

Valcir J. da C. Farias

Faculty of Statistics- Institute of Exact and Natural Sciences - Federal University of Pará – Brazil.

Marcus P. da C. da Rocha

Faculty of Mathematics- Institute of Exact and Natural Sciences - Federal University of Pará – Brazil.

Heliton R. Tavares (Corresponding author)

Faculty of Statistics- Institute of Exact and Natural Sciences - Federal University of Pará – Brazil.

E-mail: heliton@ufpa.br

Abstract

The Kalman-Bucy filter was applied on the preprocessing of the functional magnetic resonance image-fMRI. Numerical simulations of hemodynamic response added Gaussian noise were performed to evaluate the performance of the filter. After the proceeding was applied in auditory real data. The Kohonen's self-organized map was employed as tools to compare the performance of the Kalman's filter with another type of pre-processing. The results of the application of Kalman-Bucy filter for simulated data and real auditory data showed that it can be used as a tool in the temporal filtering step in fMRI data.

Keywords: Kalman Filter, Temporal Filtering, fMRI, Self-organizing maps.

1. Introduction

There are several techniques used to study the mapping of neural activation in the human brain noninvasively. Among these techniques we can mention positron emission tomography (PET), magnetoencephalography (MEG), Single Photon Emission Computer Tomography (SPECT), electroencephalography (EEG) and the functional magnetic resonance Imaging (fMRI).

From the variety of techniques involved in assessing brain activity through images, the most used technique is the acquisition of functional magnetic resonance images (fMRI) (Huettel et al., 2004). This technique is based on the phenomenon of nuclear resonance. The fMRI analyzes the hemodynamic variation and has the distinction of not submitting to voluntary harmful effects.

In a functional magnetic resonance image experiment, the subject remains within a resonance equipment where he is submitted to various stimuli. The neural activity to stimuli causes an increase in blood flow and oxygenation in blood vessels located in the brain region responsible for the activity in question. The

mechanism of BOLD (Blood Oxygen Level Dependent) contrast is the answer to the application of the experimental protocol consisting of periodic changes between stimulus and non-stimulus.

The temporal evolution of the BOLD effect (Hemodynamic Response Function) is a time series for each voxel of the functional images. The signal acquisition is done over several cycles of stimulation and rest so that the signal of interest is approximately a square wave with constant period.

The BOLD effect gives rise to the change in signal intensity captured which is restricted to a particular area of the brain and this variation is transitory in time with respect to the stimulus. However, these effects are low intensity and corrupted by noise and artifacts. One of the most challenging aspects of fMRI is to find methods to mitigate the noise present in the signal captured, because the technique is susceptible to various noise sources, causing inaccuracies temporal and spatial in the data.

Among the sources that cause these inaccuracies, we can mention the noise due to unintentional movement of the head, or noise derived from the heart beat or noise arising from the respiration or noise caused by other processes, such as differences in acquisition time of images, noise due to imperfections in the hardware and noise caused by interference from other stimuli unrelated to the task of interest.

The time series in an fMRI experiment usually have a low Signal to Noise Ratio (SNR). Thus, it becomes necessary some type of preprocessing for filtering noise in the signal. The pre-processing techniques are used to reduce the influence of most noises mentioned above on the signal. If fMRI data are processed without the application of a technique for pre-processing, the signal to noise ratio (SNR) will be low. Furthermore, the variability that is not associated with an experimental stimulus is reduced with the application of pre-processing. Such variability can reduce or even invalidate the power to detect brain areas considered active or inactive in an experiment. Among preprocessing stages, one can cite: the realignment; spatial filter and time filter.

In temporal filtering, the goal is to attenuate undesired components in the time series, without damaging the signal of interest, that is, it is important to keep after the filtering process the shape of the original signal.

The temporal filtering enhances the quality of fMRI data improving this way the signal to noise ratio. As opposed to the spatial filter which operates on each volume separately, the temporal filtering operates in the time series of the voxels separately, a series of each time. As in fMRI data, many processing techniques are applied directly in the time series, the temporal filtering usually occurs after all stages of the preprocessing.

Several authors applied temporal filters for preprocessing of fMRI data. Kruggel et al. (1999) made comparisons of filtering methods for fMRI datasets, they investigated the correction of baseline and signal restoration. Ngan et al. (2000) applied a time-varying filter based on the theoretical work of Nowak and Baraniuk (1999), such a filter operates under the stationary wavelet transform framework, where they showed that the filter had a good estimate of the true signal. Bannister et al. (1999) applied linear and non-linear filters for fMRI temporal analysis, and their results shown that in general the linear filter is better than the non-linear filter for the signal restoration.

In this paper, the Kalman-Bucy filter (Kalman, 1960; Kalman and Bucy, 1961; Rocha and Leite, 2003; Rocha et al., 2007) will be applied to realize the preprocessing of the fMRI data. It is made an adaptation in this method for filtering periodic signals so as to preserve morphology and amplitude of the original

signal. To make the analysis of the data after the application of the Kalman-Bucy filter, it is used the Kohonen's self-organized map (SOM) (Campelo et al., 2014; Haykin, 2001; Liao et al., 2008). The data will be also analyzed by the SOM without the application of the Kalman-Bucy filter for purpose of comparison and efficiency analysis of the procedure adopted here.

2. Material and Methods

The work of Kalman (Kalman, 1960) are referred in the literature as a significant contribution to the process of retrieving messages contaminated with noise, from the work of Wiener (Wiener, 1949). Essentially, the Kalman filter method is the Wiener solution to the problem of non-stationary processes, by means of transformation of an integral equation at a differential equation most appropriate for numerical calculation. From the description of the simplest Wiener-Kolmogorov problem, the stationary form, whose objective it is to obtain an optimum-filter function, time-invariant, $h(t)$, that operates on the measured signal $z(t)$ and minimizes the mean square error between real output $\hat{x}(t)$ (estimated signal) and the desired output $x(t)$.

The cost function of minimizing is given by

$$E\{h(t)\} = E\{[\hat{x}(t) - x(t)]^2\}$$

that results in the normal equations between deviations and observations,

$$E\{[\hat{x}(t) - x(t)] \cdot z(t)\} = 0$$

The basic formulation of filter operation is given by the convolution integral:

$$\hat{x}(t) = \int_{-\infty}^{+\infty} h(\tau) z(t - \tau) d\tau \quad (1)$$

where $h(t)$ is a unknown time-invariant operator (optimum filter) which it must satisfies the Wiener-Hopf equation:

$$\phi_{xz} = \int_{-\infty}^{+\infty} h_w(\tau) \phi_{zz}(t - \tau) d\tau \quad (2)$$

where ϕ_{xz} e ϕ_{zz} are the cross correlation and stochastic autocorrelation functions.

To specify the optimum filter of Wiener-Hopf (WH) it is necessary to solve equation (2), which presents the disadvantage of supposing stationarity of the process and this is not satisfied by the characteristics of the problem in study. It is necessary to make a generalizations of the problem of WH to non-stationarity processes ($h(t, \tau)$) and restrict the operation to a moving window. However, these conditions are not satisfied by integral of convolution. So, equation (2) will be rewritten in the form of a moving average according to Wiener-Kolmogorov theory which established the relation:

$$\phi_{xz}(t, \sigma) = \int_{t_0}^t h(t, \tau) \phi_{zz}(\tau, \sigma) d\tau \quad (t_0 \leq \sigma \leq t), \quad (3)$$

and the estimated value equation is given by

$$\hat{\underline{x}}(t) = \int_{t_0}^t \underline{h}(t, \tau) \underline{z}(\tau) d\tau . \quad (4)$$

Equation (3) is a bootton integral and it is usually difficult to solve, but an approach was developed using state variables to describe nonstationary processes (Rocha and Leite, 2003). Kalman and Bucy (1961) have converted the integral in a first-order differential equations system which are more suitable to solve than (3).

2.1 Kalman-Bucy Solution

The problem solution ((3) and (4)) is initiated with an ordinary differential equation of order $N-1$ that expresses the relation between the input and output in a system, given by

$$\sum_{n=1}^{N-1} a_n(t) \frac{d^n y(t)}{dt^n} = w(t) \quad (a_1 = 1) . \quad (5)$$

The transformation of (5) for state variables $x_n(t)$ and $\dot{x}_n(t)$ is done by substituting the derivatives of $y(t)$ according to the rule

$$x_1 = y, x_2 = \dot{y}, x_3 = \ddot{y}, \dots, x_N = y^{N-1} \quad (6)$$

$$\dot{x}_1 = x_2, \dot{x}_2 = x_3, \dot{x}_3 = x_4, \dots, \dot{x}_{N-1} = x_N \quad (7)$$

$$\dot{x}_N = -(a_1 x_1 + a_2 x_2 + \dots + a_N x_N) + w(t) . \quad (8)$$

The change of variables results in the state dynamic equations. The most general case, (6) and (7), are continuous and time-variant

$$\dot{\underline{x}}(t) = \underline{F}(t)\underline{x}(t) + \underline{G}(t)\underline{w}(t) \quad (\text{system}) \quad (9)$$

$$\underline{z}(t) = \underline{H}(t)\underline{x}(t) + \underline{v}(t) , \quad (\text{measurement}) \quad (10)$$

where the vector $\dot{\underline{x}}(t)$ is state variable and the matrices $\underline{F}(t)$, $\underline{G}(t)$ and $\underline{H}(t)$ are dependent on t ; the vector $\underline{w}(t)$ is state generating (signal); and the vector $\underline{z}(t)$ is the selected output from $\underline{H}(t)$; $\underline{v}(t)$ is the added white noise to the process.

In Kalman–Bucy solution it is necessary to define the specific priori stochastic properties to the processes $\underline{z}(t)$, $\underline{w}(t)$ and $\underline{v}(t)$ related in the autocorrelation and the stochastic cross correlation. Such a priori

condition is formed by the autocorrelations of white noise series, and by null cross correlations in the window of definition of the governing integral equation, and they are

$$E\{\underline{w}(t)\} = 0; \quad \underline{\phi}_{ww}(t, \tau) = E\{\underline{w}(t)\underline{w}^T(\tau)\} = \underline{W}(t)\delta(t - \tau) \quad (11)$$

$$E\{\underline{v}(t)\} = 0; \quad \underline{\phi}_{vv}(t, \tau) = E\{\underline{v}(t)\underline{v}^T(\tau)\} = \underline{V}(t)\delta(t - \tau) \quad (12)$$

$$\underline{\phi}_{wz}(t, \tau) = E\{\underline{w}(t)\underline{z}^T(\tau)\} = 0 \quad \underline{\phi}_{wv}(t, \tau) = E\{\underline{w}(t)\underline{v}^T(\tau)\} = 0 \quad (13)$$

$$\underline{\phi}_{xv}(t, \tau) = E\{\underline{x}(t)\underline{v}^T(\tau)\} = 0 \quad \underline{\phi}_{wx}(t, \tau) = E\{\underline{w}(t)\underline{x}^T(\tau)\} = 0, \quad (14)$$

where $\delta(t)$ is the Dirac's delta function that multiplied for $\underline{W}(t)$ and $\underline{V}(t)$ define diagonal matrices to the autocorrelation as priori conditions. Reorganizing the equations (8)-(11), one obtains the linear and nonlinear differential equations. Solutions in the continuous form are summarized in Table 1.

Table 1 Dynamics equations of the Kalman-Bucy Filter in the continue form.

System	$\dot{\underline{x}}(t) = \underline{F}(t)\underline{x}(t) + \underline{G}(t)\underline{w}(t)$
Measurement	$\underline{z}(t) = \underline{H}(t)\underline{x}(t) + \underline{v}(t)$
Initial conditions	$E\{x(0)\} = 0, E\{(\underline{x}(0) - \hat{\underline{x}}_0)(\underline{x}(0) - \hat{\underline{x}}_0)^T\} = P_0$
State estimate	$\hat{\underline{x}}(t) = [\underline{F}(t) - \underline{K}(t)\underline{H}(t)]\hat{\underline{x}}(t) + \underline{K}(t)\underline{z}(t)$
Ricatti equation	$\dot{\underline{P}}(t) = \underline{F}(t)\underline{P}(t) + \underline{P}(t)\underline{F}^T(t) - \underline{P}(t)\underline{H}^T(t)\underline{V}^{-1}(t)\underline{H}(t)\underline{P}(t) - \underline{G}(t)\underline{W}(t)\underline{G}^T(t)$
Gain matrix	$\underline{K}(t) = \underline{P}(t)\underline{H}^T(t)\underline{V}^{-1}(t)$

2.2 Kalman-Bucy Filter and fMRI

To model the hemodynamic response function with paradigm in block, it will be used the model proposed by Friston et al. (2000) with the parameters presented by Hu et al. (2009). Figure 1 show a simulated hemodynamic response function, $x(t)$, with zero mean and variance σ_a^2 . To the signal $x(t)$ is included an additive noise $v(t)$ with zero mean and variance σ_v^2 to obtain the measured signal $z(t)$, that is, $z(t) = x(t) + v(t)$.

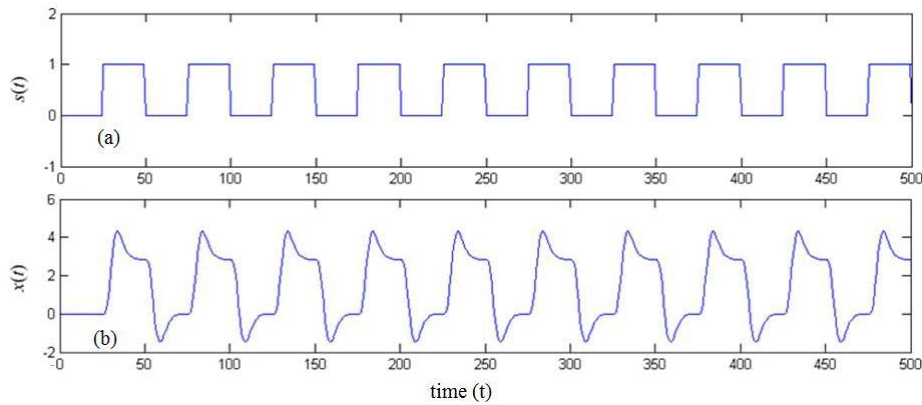


Figure 1 – (a) stimulus function for a block design. (b) Block design response

So, the stochastic properties to model are established, and they are summarized below:

$$E\{\underline{x}(t)\} = 0; \quad \underline{\phi}_{xx}(t_1, t_2) = E\{\underline{w}(t)\underline{w}^T(\tau)\} = \sigma_a^2 \delta(t - \tau) \quad (15)$$

$$E\{\underline{v}(t)\} = 0; \quad \underline{\phi}_{vv}(t_1, t_2) = E\{\underline{v}(t)\underline{v}^T(\tau)\} = \sigma_v^2 \delta(t - \tau) \quad (16)$$

$$E\{\underline{w}(t)\} = 0; \quad \underline{\phi}_{ww}(t_1, t_2) = E\{\underline{w}(t)\underline{w}^T(\tau)\} = \sigma_a^2 \delta(t - \tau) \quad (17)$$

To solve the proposed problem, it is necessary to define the state variables, as below:

$$x_1(t) = x(t) = y(t) \quad x_2(t) = \dot{x}_1(t) = \dot{x}(t) = w(t). \quad (18)$$

By comparing (18) with (6), (7) and (8), one obtain

$$\dot{x}_1 = 0 + w(t) \quad y(t) = x_1(t) \quad (19)$$

and

$$\underline{F} = 0 \quad \underline{G} = 1 \quad \underline{H} = 1. \quad (20)$$

By replacing (19) and (20) in Ricatti equation (Table 1), one obtain

$$\dot{\underline{P}}(t) = -\underline{P}(t)\underline{V}^{-1}\underline{P}(t) + \underline{W}(t) \quad (21)$$

and the gain matrix is given by

$$\underline{K}(t) = \underline{P}(t)\underline{H}(t)\underline{V}^{-1}(t). \quad (22)$$

By rearranging the terms, one obtains a differential equation of the covariance of the error in scalar form

$$\frac{dp(t)}{dt} = -\frac{p^2(t)}{\sigma_v^2} + \sigma_a^2 \quad (23)$$

and the gain in scalar form, given by

$$K(t) = \frac{p(t)}{\sigma_v^2}.$$

By solving (23), one obtain

$$p(t) = \sigma_v^2 \sqrt{\gamma} \tanh(\sqrt{\gamma} t)$$

and

$$K(t) = \sqrt{\gamma} \tanh(\sqrt{\gamma}t) \quad (24)$$

where

$$\gamma = \frac{\sigma_a^2}{\sigma_v^2}.$$

By replacing (24), (19) and (20) in State estimate (Table 1), one obtain the differential equation of the state estimate of the Kalman filter

$$\frac{d\hat{x}(t)}{dt} = -\sqrt{\gamma} \tanh(\sqrt{\gamma}t)\hat{x}(t) + \sqrt{\gamma} \tanh(\sqrt{\gamma}t)z(t). \quad (25)$$

It will be applied to the differential equation (25) which represents the state estimative of the Kalman filter in the scalar form. Based on these theoretical considerations, it was developed a computational algorithm for the implementation of the Kalman-Bucy filter on fMRI data, in which the quality of the filter will be specified by parameter γ . The Kalman-Bucy filter operates in the time series of voxels, $z(t)$, separately, a time series at a time. The application of the Kalman-Bucy filter on time series occurs in windows defined by sequential cycles of rest and stimulation. Figure 2 illustrates the design of the windows for the application of the Kalman-Bucy filter. Each window is formed by a period of activation alternated with a period of rest. Figure 3 shows the application of the Kalman filter with windows in a certain interval ($t_o \leq \tau \leq T$). The hyperbolic shape of the linear operator $h(t)$ is evidenced after the application of the filter in the interval ($t_o \leq \tau \leq T$). The parameter γ was considered constant in the windows.

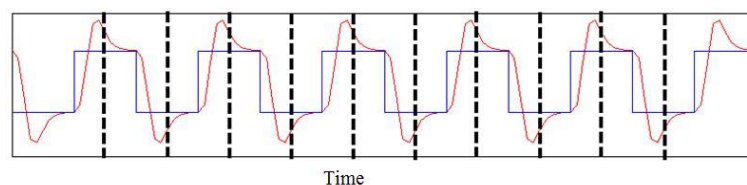


Figure 2 - Windows for application of the filter.

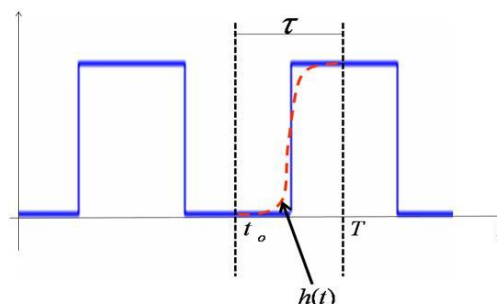


Figure 3 - Illustration of the filter application window ($t_o \leq \tau \leq T$) and the hyperbolic form of the linear operator

2.3 Self-Organizing Maps

fMRI data were analyzed with Kohonen's SOM (Kohonen, 2001) using an implementation available in the literature (Fischer and Henning, 1999; Ngan et al., 2002; Peltier et al., 2003; Campelo et al., 2014). Kohonen's SOM is an artificial neural network where neurons are disposed as a uni- or bi-dimensional grid layout. In a bi-dimensional layout, the geometry is free and can be rectangular, hexagonal, triangular etc. In a SOM, each neuron in a grid is represented by a probability distribution function of the input data. The SOM algorithm responsible for map formation begins initializing the grid neurons weights with random values, which can be obtained from the input data. In the present work, it was used a bidimensional grid of dimension 10×10 . Each neuron in the grid is connected to every element of the input dataset, i.e., the dimension of weights m is the same as the input dataset:

$$m_i = [m_{i1}, m_{i2}, \dots, m_{in}]^T \in \mathbb{R}^n$$

where n indicates the total amount of points available in the time series generated by the fMRI experiment. After each iteration t of the ANN, we selected randomly a vector from the input dataset, given by:

$$x_i = [x_1, x_2, \dots, x_n]^T \in \mathbb{R}^n$$

which indicates the time series of a given voxel from the fMRI dataset. Then x is compared to all the weights of the grid, with frequent use of the minimum Euclidean distance as similarity criterion for choosing a winner neuron (Fischer and Henning, 1999; Peltier et al., 2003). However, the correlation as a similarity criterion reveals itself better than the conventional Euclidean distance (Liao et al., 2008), the choice of the winning neuron c given by:

$$m_c = \arg \max \{ \text{corr}(x(t), m_i(t)) \},$$

with $i = 1, \dots, M$, where M is the total number of neurons in the grid, $m_c(t)$ represents the time series of the winner c and $\text{corr}(x(t), m_i(t))$ is the correlation coefficient between $x(t)$ and $m_i(t)$.

The updating of the weight vector $m(t+1)$ in time $t+1$, with $t = 1, 2, \dots$ is defined by:

$$m_i(t+1) = m_i(t) + h_{ci}(t)[x(t) - m_i(t)] \quad (26)$$

which is applied to every neuron on the grid that is within the topological neighborhood-kernel from the winner neuron. Equation (26) has the goal of approximating the weight vector m_i of neuron i towards the input vector, following the degree of interactions h_{ci} . This approach transforms the grid, after training, in a topologically organized characteristic map, in the sense that adjacent neurons tend to have similar weights. A function frequently used to represent the topological neighborhood-kernel h_{ci} is the Gaussian function, which is defined by:

$$h_{ci}(t) = \alpha(t) \exp \left\{ -\frac{\|r_c - r_i\|}{2\sigma^2(t)} \right\},$$

where $\alpha(t)$ is the learning rate, which has to gradually decrease along time to avoid that new data gathered after a long training session could compromise the knowledge already sedimented in the ANN; r_c and r_i

determine the discrete position of neurons c and i in the grid and $\sigma(t)$ defines the topological neighborhood radius, i.e., defines the full-width at half-maximum (FWHM) of the Gaussian kernel. The parameters $\alpha(t)$ and $\sigma(t)$ gradually decrease by t/τ (τ is a time constant) after each iteration t , following an exponential decay.

After the learning process of the SOM, the input data with similar patterns appear in groups in neighboring neurons on the map. However, often the amount of groups is unknown or of complex discrimination, making it difficult to distinguish such groups. A proposal for detection and automatic segmentation of the groups in the SOM map is through clustering techniques. The purpose of the clustering techniques is to form similar groups, ie groups that have a high degree of correspondence or similarity.

Several methods for grouping of neurons in the SOM have been proposed, in this paper will apply the hierarchical clustering (HC), for more details see (Liao et al., 2008, Campelo et al., 2014).

There are several mechanisms that can evaluate the quality of the generated map obtained after the learning process. In the present work it was used the quantization error:

$$E_q = \frac{1}{N} \sum \|x - m_c\|^2 \quad (27)$$

The quantization error is defined as the mean square error corresponding to the difference between each characteristic vector x and the winner neuron m_c , where N is the total number of patterns (Santos et al., 2019).

2.4 Synthetic data

To compare different values of the parameter γ , are generated artificial time series of voxels considered active, i.e. time series containing evidence of BOLD signal. Using an artificial signal, it is possible to compare the original signal, noisy signal and filtered signal, determining in this way, the factor of noise reduction δ , which it will be a metric of performance in this work.

$$\delta = \sqrt{\frac{\sum_k [z(k) - x(k)]^2}{\sum_k [\hat{x}(k) - x(k)]^2}}, \quad (26)$$

where $x(k)$ is the original signal without noise, $z(k)$ is the signal with noise and the $\hat{x}(k)$ is the filtered signal and k is the sample index.

The time series were simulated from block design paradigm, formed of 6 blocks of activation and 6 blocks of rest, where the first block was composed of rest. On the time series it was added a Gaussian noise. From these time series were simulated the 3D data with 64×64 voxels (Figure 4) with 128 samples in time. In Figure 4, the area considered active is composed with 49 voxels, the gray matter was composed of 1349 voxels and the other voxels are of the background of the image. On the time series was added noise with SNR of 5dB, 0dB and -5 dB.

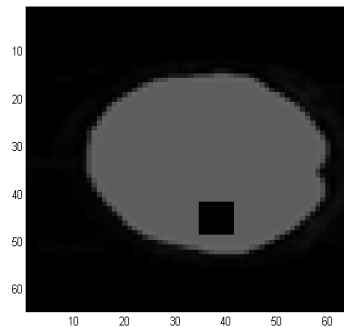


Figure 4- Simulated image: a rectangular area inside the gray matter represents a region considered active.

2.4 Real data

The fMRI experiment used a 1.5 T Siemens scanner (Magnetom Vision, Erlangen, Germany), with the following parameters for EPI (echo-planar imaging) sequences: TE = 60 ms, TR = 4.6 s, FA = 90°, FOV=220 mm, and slice thickness of 6.25 mm. 64 cerebral volumes with 16 slices each were acquired with a matrix dimension of 128×128 . During the experimental procedure the subject received auditory stimulation in a blocked design, with 5 stimulation blocks (27.5s each) intercalated with 6 resting blocks (27.5 s each). During the task, the subject listened passively to a complex story with a standard narrative structure. After the test, the subject had to inform to the experimenter its comprehension of the story content.

Acquired images were preprocessed with the software SPM8 (Statistical Parametric Mapping) in order to increase the signal-to-noise ratio (SNR) and to eliminate incident noise associated with the hardware, involuntary movements of the head, cardiac and respiratory rhythms, etc.

3. RESULTS

3.1 Synthetic data

In several tests performed, it will be presented here only the synthetic time series that were contaminated with the noise whose SNR was from -5 dB and the values of 250, 200, 150, 100 and 50 were considered to the parameter γ . Figures 5(a) and 5(b) show the original and contaminated (SNR of -5 dB) time series, respectively. Figures 5(c), 5(d), 5(e), 5(f) and 5(g) show the results of the filtering applying by Kalman-Bucy filter, respectively, with $\gamma = 250$, $\gamma = 200$, $\gamma = 150$, $\gamma = 100$ e $\gamma = 50$. One can observe that smaller the value of the parameter γ , more the signal tends to smoothen. However, the higher the level of smoothing increases the possibility of losing of the desired properties of the signal. Therefore, it is important to choose a suitable value for the parameter γ , such that the filtering remove undesired components of the time series

and keep the desired properties of the signal. That is, the quality of results from the application of the Kalman filter is related to the choice of parameter.

Through factor noise reduction (26) it was selected the parameter γ that best filters the signal. For an SNR of -5 dB it was found a factor of noise reduction $\delta_{\max} = 2.1535$ for $\gamma = 20$. Figure 6 shows the evolution of the noise reduction factor for SNR = -5dB, and Figure 7(a) shows the comparison between a time series with SNR = -5 dB (blue line) and that series filtered (red line) with $\gamma = 20$, which provides the best noise reduction factor ($\delta_{\max} = 2.1535$). Based only in Figure 7(a), it can be assumed that there is a loss in signal amplitude significantly after applying the filter, but when comparing the filtered signal with the original signal, it is noticed that the filter has performed well (Figure 7(b)), recovering good part of original form of the signal.

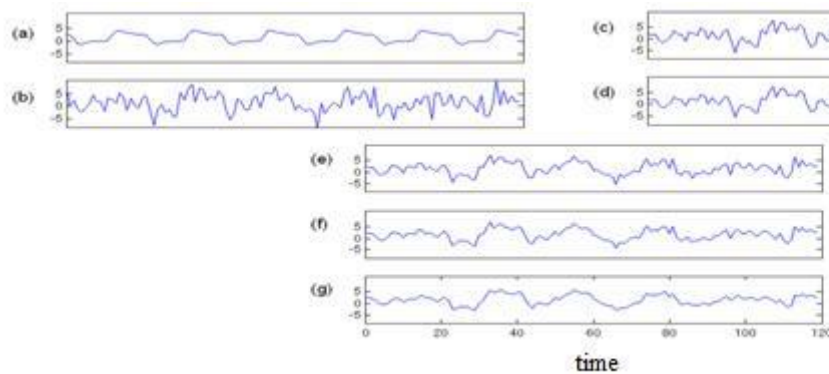


Figure 5. (a) Original signal; (b) Contaminated signal with SNR=-5dB; and filtered signal with: (c) $\gamma=250$; (d) $\gamma=200$; (e) $\gamma=150$; (f) $\gamma=100$; (g) $\gamma=50$.

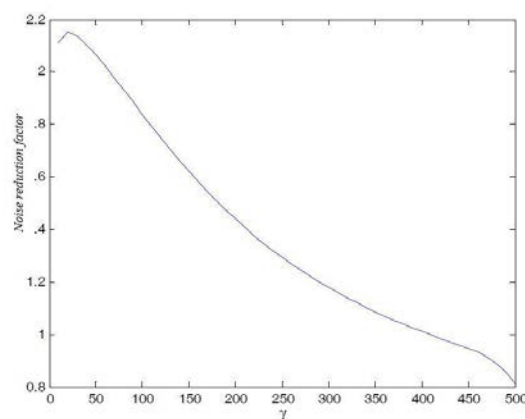


Figure 6. Noise reduction factor for a time serie contaminated with noise of SNR =-5dB.

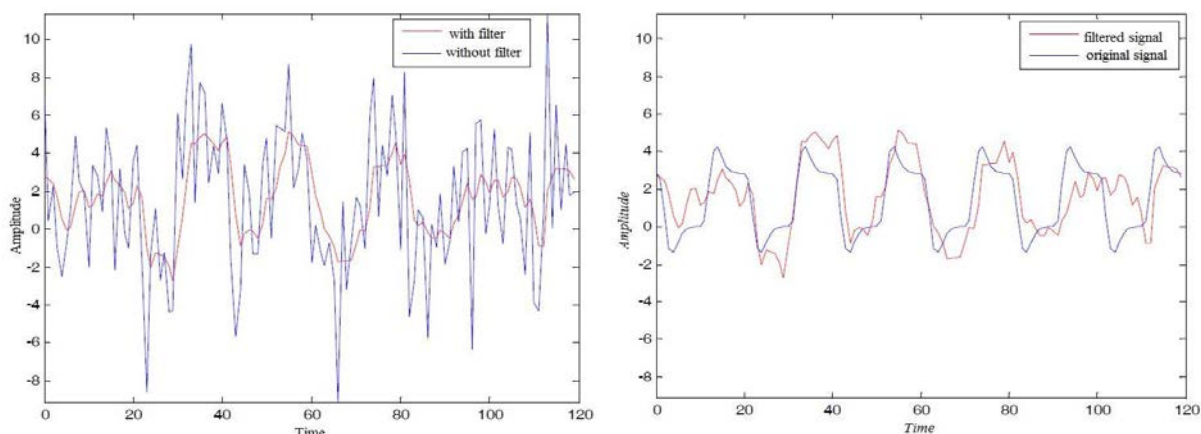


Figure 7. (a) comparison between the time series contaminated with noise of $\text{SNR} = -5$ and the time series filtered by the Kalman-Bucy filter, com $\gamma = 20$ e $\delta_{\max} = 2,1535$. (b) comparison between original signal and the filtered signal.

The self-organizing map (SOM) was applied to verify performance of the Kalman-Bucy filter on the time series of the simulated slice. For the first analysis was considered the time series of the simulated slice without applying the Kalman filter. For this data set, has been started the training stage of the SOM in a total of 150 iterations. Upon completion of this step, the SOM presented a neurons 10×10 grid shown in Figure 8(a). After the training of the SOM it was applied the hierarchical cluster to determinate the group of the neurons that present pattern of the activation. The neurons on the left bottom (highlighted in yellow) represent the activation.

In the second analysis it was applied the Kalman-Bucy filter in the dataset of the slice simulated. Then began the training of the SOM keeping the set of initial weights used in the analysis without the application of the filter (the previous analysis). Figure 8(b) shows the neurons 10×10 grid for this analysis, although to in smaller number, neurons that represent activation signals are sharper than of Figure 8(a), according to visual analysis made at the weights of the neurons grid.

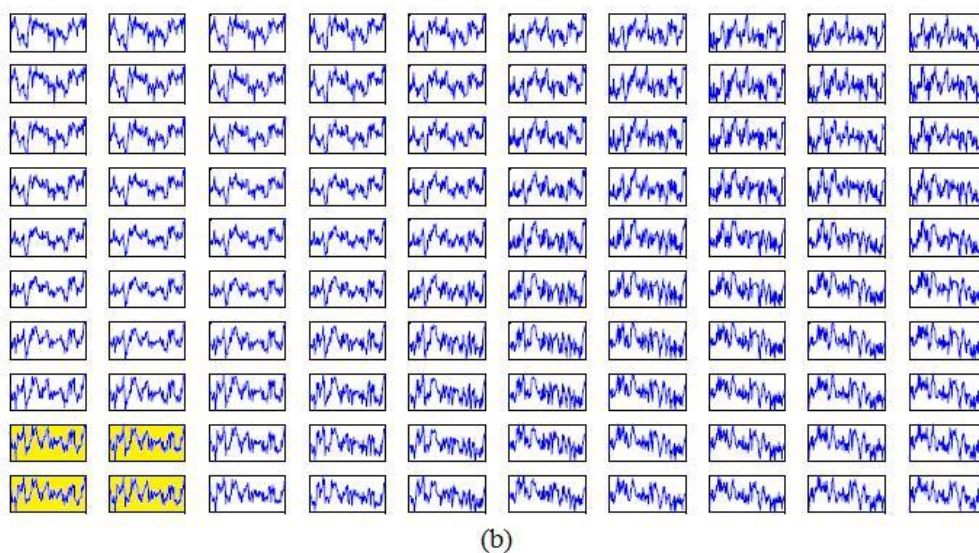
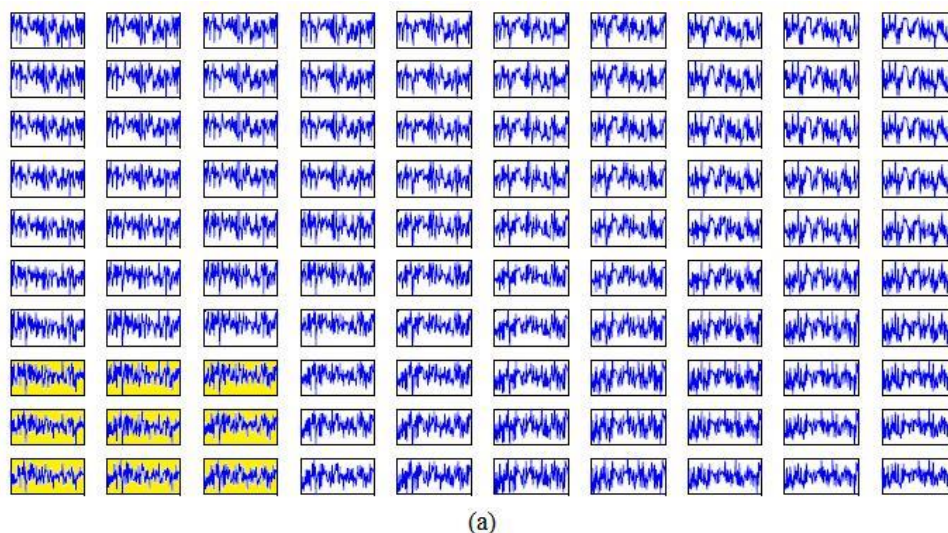


Figure 8. (a) Neurons 10x10 grid for data of simulated slice without the application of the Kalman-Bucy filter; (b) Neurons 10x10 grid for data of simulated slice with the application of the Kalman-Bucy filter. To generate the map of activation (Figure 9) it was calculated the correlation coefficient between all voxels of the areas of the brain and the average weights of the neurons belonging to group candidates. The correlation coefficient between these two signals is used as the threshold to find the voxels with greater possibilities of being actives.

The results were also compared from the quantization error curves (27). The quantization error, among other things also serves as a controller and as a comparator of quality of learning of an artificial neural network. Figure 10 shows the quantization error curves with and without the application of the Kalman filter on time series of the slice simulated. It is observed that the stabilization in both cases occurs approximately from the 70th iteration, with the amplitude of the quantization error of the curve by applying the filter being slightly smaller than the curve without the filter.

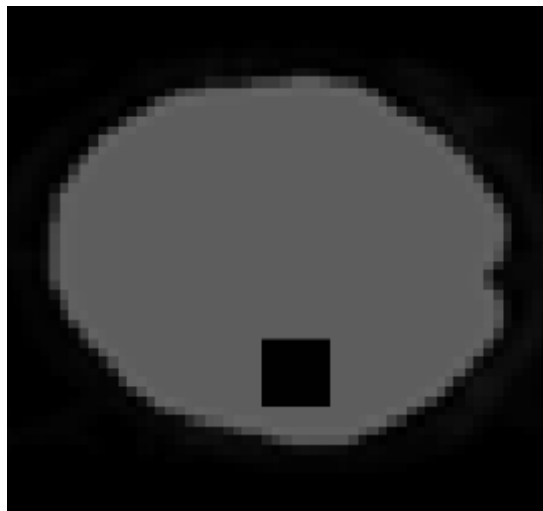


Figure 9. Activation map. The Black area inside the gray matter correspond to active region obtained by SOM.

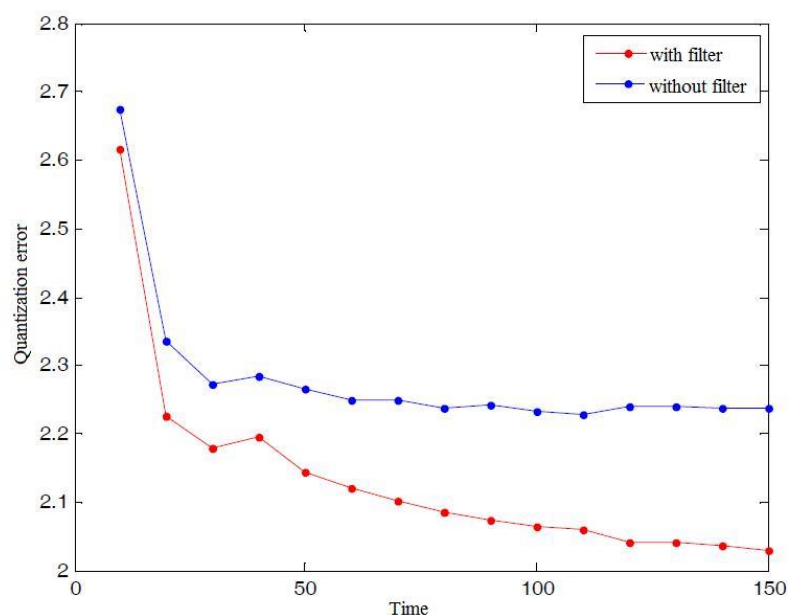


Figure 10. Comparison of the quantization error for the simulated slice with SNR = -5dB: with the application of the Kalman filter (red line), and without the Kalman filter (blue line).

3.2 Real data

In this section it is presented the results of the application of the Kalman filter on experimental fMRI data described at the Section 2.4. Once again, the self-organizing map was applied to assess the real fMRI data without and with the application of the Kalman filter.

Figure 11 (a) and (b) show evolution of the quantization error to data without and with the application of Kalman filter with $\gamma = 80$, respectively. It is observed that the amplitude of quantization error curve of filtered data is lightly lesser than that data without the filtering. After training the SOM and applying the hierarchical clustering on the eighth slice image of fMRI experimental data preprocessed with the Kalman-Bucy filter, the 10×10 neuron grid is shown in Figure 12. The group of neurons highlighted in yellow indicates activation pattern.

The map of activation made from the correlation coefficients between the time series of each voxel of the image (eighth slice) and the average of the weights highlighted in Figure 12 is shown in Figure 13. Figure 14 is presented the map of activation for data without the application of the Kalman filter. It is observed that images are similar, however, the auditory areas in Figure 13 are slightly greater than that in Figure 14.

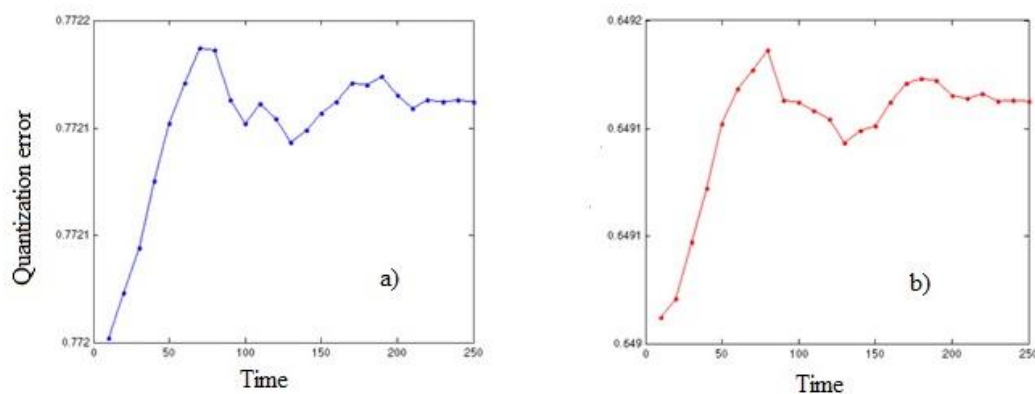


Figure 11. Quantization error: (a) without filter application; (b) with filter application.

The Kalman-Bucy filter left the weight of the neurons of the SOM grid sharper than the signal of the same weight for data without the filter application, It is possible that voxels with low BOLD signal, but that belong to active region have been detected. Explaining, thereby, the small differences between the images.

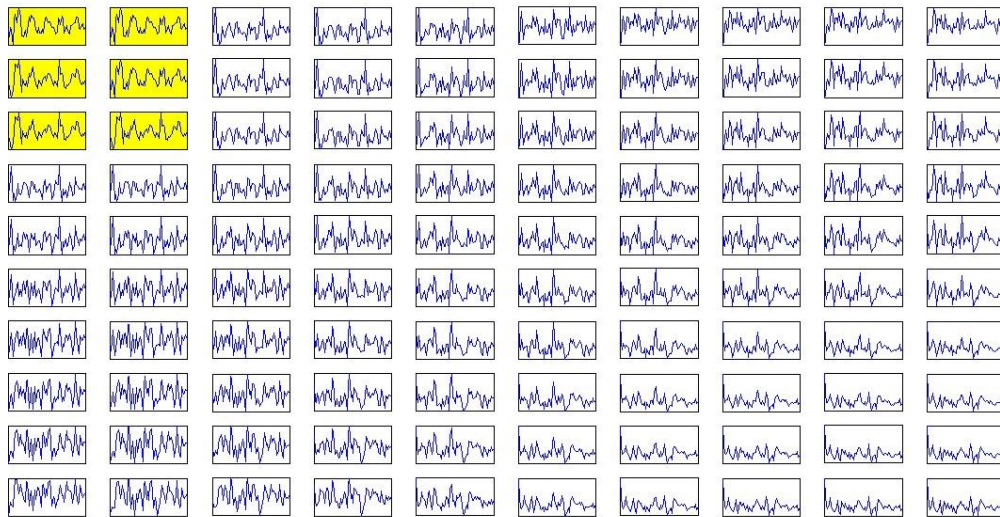


Figure 12. 10x10 neuron grid after executing the SOM algorithm, the highlighted neuron group corresponds to the activity patterns.

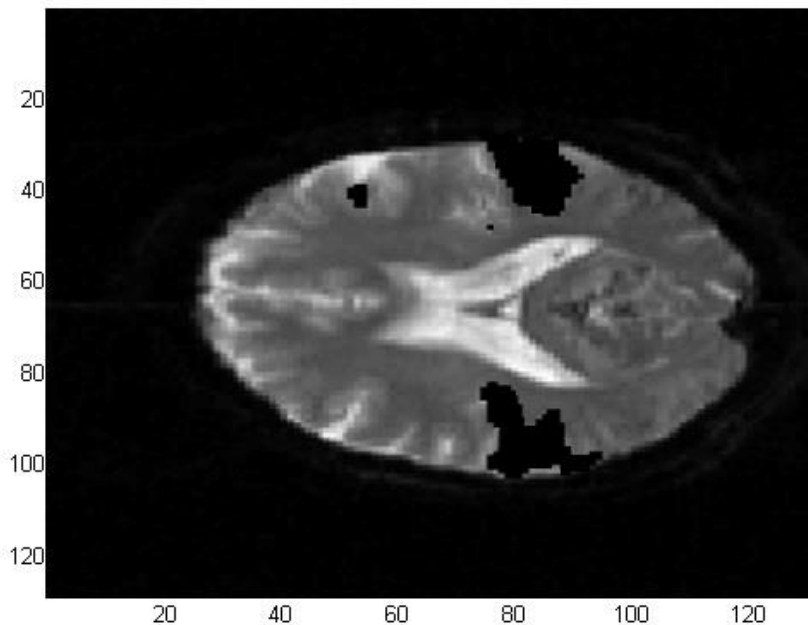


Figure 13. Result of auditory stimulation in the cerebral cortex according to SOM analysis, using data filtered by Kalman with $\gamma = 80$.

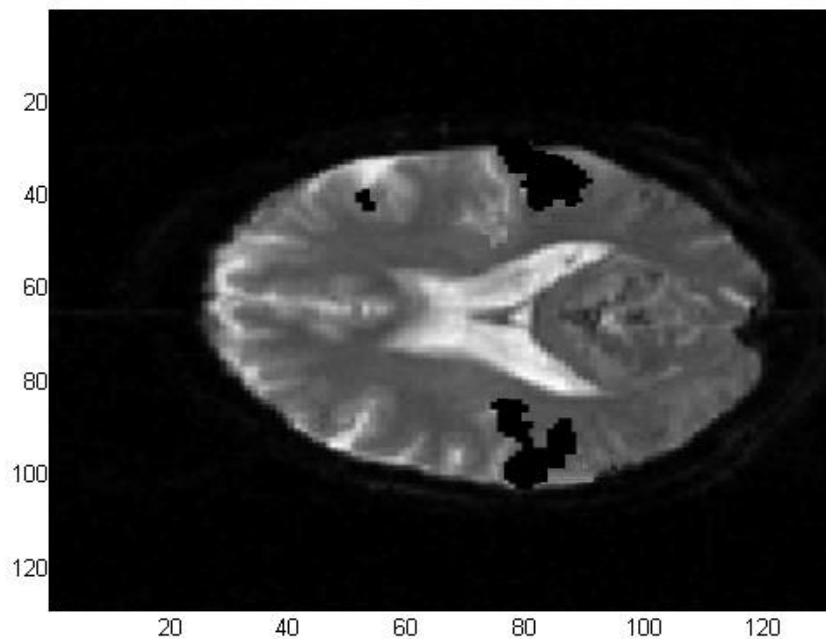


Figure 14. Result of auditory stimulation in the cerebral cortex according to SOM analysis, using data without Kalman filtering.

4. CONCLUSIONS

In this work the Kalman-Bucy approach in the differential form was applied to time series of fMRI data. The experimental results showed that the Kalman filtering can mitigate noise of fMRI data by altering slightly some details and amplitude of events and, however, preserving the characteristic morphology of signal.

In simulated and real data, Kohonen self-organizing map and hierarchical clustering were applied as analyze tools. It was used the quantization error of the SOM to verify the performance of the Kalman filter in the fMRI data preprocessing.

It was observed that the amplitude of the SOM quantization error was minor with the Kalman filter application than without filter application on the data. This result was observed for every SNR values. Regarding the stabilization of the quantization error curve, it was noted that the curves showed similar behaviors. The results showed that Kaman filter can be applied as a tool in the stage of temporal filtering of fMRI data.

5. REFERENCE

Bannister, P.; Smith, S.; Brady, M.; Flitney, D.; Woolrich, M. Evaluating Lowpass Filters for fMRI Temporal Analysis. Department of Clinical Neurology, University of Oxford, John Radcliffe Hospital, Headington, Oxford OX3 9DU, UK. www.fmrib.ox.ac.uk/analysis

Campelo, A. D. de S.; FARIAS, V. J. da C.; Tavares, H. R.; ROCHA, M. P. C. Self-organizing maps and entropy applied to data analysis of functional magnetic resonance images. Applied Mathematical Sciences (Ruse), v. 8, pp. 4953-4969, 2014.

Fischer, H., Henning, J., Neural-network based analysis of MR time series. *Magnetic Resonance in Medicine* 41:124-131, 1999.

Friston, K. J., Mechelli, A., Turner, R., Price, C. J. "Nonlinear responses in fMRI: the balloon model, volterra kernels, and other hemodynamics," *NeuroImage*, vol. 12, no. 4, pp. 466 - 477, 2000.

Haykin, S. *Neural Networks Principles and practice*. 2 ed., Bookman, São Paulo, 2001.

Hu, Z.; Zhao, X.; Liu, H.; Shi, P. Nonlinear analysis of the bold signal. *EURASIP Journal on Advances in Signal Processing*, v. 2009, pp. 1 - 13, 2009.

Huettel, S. A., Song, A. W., e McCarthy, G., 2004. *Functional Magnetic Resonance Imaging*. Sinauer Associates.

Kalman, R. E. A new Approach to Linear Filtering and Predction Problems. *ASME, Series D, Journal of Basic Engineering*, 82, pp. 35–45, 1960.

Kalman, R. E., Bucy, R. E. New results in linear filtering and prediction theory. *ASME, Series D, Journal of Basic Engineering*, 83, pp. 95–107, 1961.

Kohonen, T. *Self-Organizing Maps*. 3 ed.; Springer: Berlim, 2001.

Kruggel, F.; Von Cramon, D. Y.; Descombes, X. Comparison of Filtering Methods for fMRI Datasets. *Neuroimage*, 10, pp. 530–543, 1999.

Liao, W., Chen, H., Yang, Q., Lei, X. Analysis of fMRI Data Using Improved Self-Organizing Mapping and Spatio-Temporal Metric Hierarchical Clustering. *IEEE Transactions on Medical Imaging*, vol. 27, pp. 1472-1483, 2008.

Ngan, S. C.; LaConte, S. M.; Hu, X. Temporal Filtering of Event-Related fMRI Data Using Cross-Validation. *NeuroImage*, 11, pp. 797–804, 2000.

Nowak, R. D., and Baraniuk, R. G. Wavelet-domain filtering for photon imaging systems. *IEEE Trans. Image Process.*, 8, pp. 666–678,1999.

Peltier, S. J., Polk T. A., Noll D.C. Detecting low-frequency functional connectivity in fMRI using a self-organizing map (SOM) algorithm. *Hum. Brain Mapp.*, vol. 20, pp. 220-226, 2003.

Rocha, M. P. C., Leite, L. W. B. Treatment of geophysical data as a non-stationary process. *Computational and Applied Mathematics*, Vol. 22, N. 2, pp. 149–166, 2003.

Rocha, M. P. C.; Leite, L. W. B.; Santos, M. L.; Farias, V. J. C. Attenuation of multiple in reflection seismic data using Kalman-Bucy filter. *Applied Mathematics and Computation*, v. 189, p. 805-815, 2007.

Ribeiro, R. C. M., Quadros, T. A., Ausique, J. J. S., Chase, O. A., Campos, P. S. da S., Júnior, P. C. dos S., Almeida, J. F. S. de, & Marques, G. T. (2019). Forecasting incidence of tuberculosis cases in Brazil based on various univariate time-series models. *International Journal for Innovation Education and Research*, 7(10), 894-909. <https://doi.org/10.31686/ijer.vol7.iss10.1841>

Wiener, N. *Extrapolation, Interpolation, and Smoothing of Stationary Time Series*. New York. John Wiley and Sons. 1949.

Review of Clinical Factors That Cause Acne Vulgaris

Zípora M. Q. Dos Santos^{1,2}, Maiara C. Velho¹, Fátima R. Zan³, Virginia C. Rech^{1,2}, Aline F. Ourique^{1,2*}

¹ Laboratory of Nanotechnology, Universidade Franciscana, Santa Maria, Brazil

² Graduate Program in Nanosciences, Universidade Franciscana, Santa Maria, Brazil

³ Innovation and Technology Transfer Center, Instituto Federal Farroupilha, Santo Ângelo, Brazil.

* **Correspondence:** Prof. Aline Ferreira Ourique, Professor Graduate Program in Nanosciences, Universidade Franciscana, Santa Maria, Brazil. Phone: +55 55 32201200. E-mail address: alineourique@gmail.com, <https://orcid.org/0000-0003-0828-774X>

Abstract

Acne vulgaris is a common skin disorder caused by inflammation and/or blockage of the pilosebaceous follicle. This research is a literature review study that is descriptive in nature and seeks to compile information on the factors related to the etiopathogenesis of the clinical manifestations of acne vulgaris. A survey was conducted in the Web of Science database in the period from January to May 2020, using the keywords "acne vulgaris, etiopathogenesis and pathophysiology". The etiopathogenesis of acne vulgaris is multifactorial, but most studies list the following factors: like diet, daily habits, age, genetics, abnormalities in the production of sebum, follicular hyperkeratinization, increased colonization by Cutibacterium (formerly Propionibacterium) acnes, periglandular dermal inflammation, oxidative stress and immune reactions of the patient. Topical and/or systemic treatments for acne vulgaris, often includes retinoid-associated antibiotics. However, improper use of these can lead to bacterial resistance, in addition, it may trigger adverse effects at epidermis and dermis. The results obtained in this study are important in relation to the treatment of the pathogenesis of acne vulgaris. It is believed that this information - when analyzed together - can help with a better definition of the therapeutic protocol.

Key-words: skin disorder, pilosebaceous follicle, etiopathogenesis, pathophysiology.

Financial Support

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

Introduction

Acne vulgaris is the most prevalent skin disease in the world, affecting proximately 650 million people or about 9.4% of the population globally.¹

Although acne vulgaris is the most frequent disease in young people, little has been reported about the multifactorial aspect of the pathophysiology of acne vulgaris.²⁻⁴ As such, this study sought to identify

the factors related to the etiopathogenesis of the clinical manifestations of acne vulgaris through a literature review of a descriptive nature. A survey was conducted in the *Web of Science* database in the period from January to May 2020, using the keywords "*acne vulgaris, etiopathogenesis, and pathophysiology*", articles with content relevant to the topic were selected.

Etiopathogenesis of Acne Vulgaris

Acne vulgaris is a severe chronic inflammatory dermatosis and it manifests in the pilosebaceous follicle.⁵ Its etiopathogenesis is multifactorial, but research points to the following factors: like diet, daily habits, age, genetics, abnormalities in the production of sebum, increased follicular keratinization, periglandular dermal inflammation, oxidative stress, assessments of immune systems to patients and changes in the microbial skin community, which are affected by innate immunity can lead to a chronic inflammatory condition.^{2,6} This disease affects the quality of life and has psychosocial implications for affected individual.^{7,8} It also generates other negative effects, such as unaesthetic characteristics, edema, tissue sensitization, and in some cases, scarring.^{9,10}

It is often treated with antibiotics like tetracycline, erythromycin, and clindamycin, which are administered topically or systemically, in association with topical medications such as benzoyl peroxide, retinoids like isotretinoin or azelaic acid, or in the form of monotherapy with antiandrogens like flutamide.^{11,12} Therapy with these products against the acne-promoting bacteria has led to the development of resistance to antimicrobials.^{2,5,6}

Although they produce significant effects in the treatment of acne vulgaris, they may trigger intolerable adverse effects, such as severe dryness of the mucous membranes and the skin, itching, scaling, erythema, contact dermatitis, hepatic complications, toxicity to sebocyte, increased levels of triglycerides and cholesterol and teratogenesis.^{3,4,12}

This pathology is classified as inflammatory and non-inflammatory in accordance with the predominant lesions, and can be graded from I to V according to the severity of the condition.¹³ Grade I acne is comedonian, non-inflammatory, it features comedones formed by the accumulation of sebum and keratin in the pilosebaceous follicle. Inflammatory acne is responsible for the grade II, III, IV and V conditions. In grade II acne, there are papular-pustulous lesions in addition to the comedones. Cysts and nodules can be found in grade III acne. Grade IV or conglobate acne is a severe form of the disease with multiple inflammatory nodules and the formation of abscesses and fistulas in the tissue. Finally, grade V acne is rare and severe, occurring abruptly and accompanied by systemic manifestations (fever, leukocytosis and arthralgia).^{14,15}

With the severity of the condition, the skin may develop scars, causing great concern to the patient regarding the unaesthetic characteristics of the image.³ Post-acne scars can be formed through a sequence of abnormal wound healing after lesions that occurs in the pilosebaceous follicle.¹⁶

Often, changes are observed in the sebum components of the skin of patients with this disease, especially in the levels of squalene and linoleic acid. Studies have reported that low concentrations of linoleic acid in the tissue influence glandular epithelial wall protection, which can then be affected by free fatty acids, obtained through the hydrolysis of triglycerides by the lipases of *Cutibacterium* (formerly *Propionibacterium*) *acnes* (*C. acnes*), causing hyperkeratinization and dermal inflammation (Fig. 1).^{17,18}

Sebaceous Hyperactivity

In normal conditions, the activity of the sebaceous gland is of fundamental importance for transepidermal permeation. In addition to preventing desiccation of the skin's surface, lubricating the hair and forming a hydrolipidic layer in conjunction with the products secreted by the sudoriferous glands.¹⁹

Essential fatty acids play a crucial role in the pathogenesis of acne.¹³ Linoleic acid is a natural constituent of sebum and animal model studies have shown that a significant reduction of linoleic acid concentrations in the sebum is correlated with the increase of comedogenesis.¹⁷

Individuals with acne vulgaris have lower concentrations of linoleate in the sebum, which increases the keratinization of the ductal wall and makes the comedo wall more permeable to the mediators of the inflammatory process.²⁰

A pilot study using dietary supplementation with a total of 3 g per day of linoleic, linolenic and gamma-linolenic acids resulted in a quantitative reduction of the size of sebaceous glands, visualized by cutaneous biopsies after three consecutive months of supplementation.²¹

The hyperinsulinemia can directly stimulate the production of sebum, increasing androgen synthesis.¹⁷

The sebaceous glands develop and are stimulated by androgenic hormones.²² Dihydrotestosterone (DHT), resulting from the local conversion of testosterone by the enzyme 5-alpha-reductase (5- α R), is the main androgen determining the increased production of sebum. The enzyme 5- α R is responsible for the conversion of testosterone into DHT, which in turn modulates sebaceous secretion. When in higher activity in the infundibular keratinocytes, it induces the greater capacity of these cells to produce active androgens, thus increasing the production of sebum.²³

Infundibular Hyperkeratinization

The primary function of the keratinocytes is to produce keratin, a fibrous protein with a three-dimensional structure conferring resistance, elasticity and impermeability to water. In normal conditions, the constant cell renewal in the epidermis causes the cells of the corneal layer to be gradually eliminated and replaced by others.²⁴

However, follicular hyperkeratinization in the upper region of the hair follicle may contribute to the obstruction of the duct with byproducts generated in the sebaceous gland. The hydrolytic proteases produced by *C. acnes* can then act on the glandular epithelium, leading to rupture and subsequent expulsion of the sebaceous content to the dermis. With this, sebaceous lipids are injected into the dermis by *C. acnes*, and cornified epitheliocytes produce a humoral-type response, establishing the inflammation.¹⁷

Infundibular Bacterial Colonization

Although it belongs to the normal bacterial flora of the skin and hair follicles, *C. acnes* is the main microorganism involved in the etiopathogenesis of acne vulgaris.²¹ This bacterial hydrolyzes triglycerides, producing free fatty acids and glycerols that irritate the follicle wall induce keratinization, and the formation of comedogenic byproducts triggering an inflammatory process, which depending on the severity may form papules, pustules, nodules and cysts.^{17,23}

C. acnes is able to modulate the proliferation and differentiation of keratinocytes by inducing

filaggrin and integrin expression.²⁵ Previous studies have shown a correlation between type I insulin-like growth factor (IGF-I) and the serum levels of the severity of acne in women,²⁶ and they showed that the IGF-1 levels are directly related to the quantity of sebum in the skin; the inhibition of the type I insulin-like growth factor receptor (IGF-1R) results in a reduction of the epidermis.²⁷

Neutrophils are attracted by the presence of intrafollicular material in the dermis and phagocyte *C. acnes* without destroying it. As a consequence, the hydrolases destroy the tissue wall, and activation of the complement system occurs with the production of C5 α , another potent neutrophil chemotactic factor.¹⁷

Follicular and Underlying Dermal Inflammation

The inflammation can occur both by an irritating action of the sebum, which overflows to the dermis when there is rupture of the follicular wall, and through the presence of chemotactic factors and pro-inflammatory mediators produced by *C. acnes*.²⁷ Studies on *C. acnes* have demonstrated some properties that contribute to the local inflammatory response, such as the production of enzymes that facilitate follicular rupture, the existence of surface proteins that stimulate cellular and humoral immune response, thus damaging the adjacent tissues to inflammation.^{17,28}

The body's first line of defence against infectious diseases is the innate immune response of the organism.²⁹ *C. acnes* cooperates in the activation of this response.³⁰ The components of this bacterium can activate the toll-like receptors (TLR-2 -2).¹⁷ These receptors are able to mediate the response to standard molecules associated with pathogens.³¹

Signs of intracellular cytokines activate monocytes and macrophages, which release the tumor necrosis factor alpha (TNF- α), interleukin-1 beta (IL-1 β), interleukin-6 (IL-6), reactive oxygen species (ROS), prostaglandin eicosanoid type 2 (PGE2) and nitric oxide (NO), all inflammatory mediators (Fig. 2).²⁹ The mitogen-activated protein kinases (MAPKs) include the extracellular-signal-regulated kinases (ERKs), protein 38 (p38) and the *c-jun N-terminal kinase* (JNK). These mediators play a crucial role in regulating cellular responses to pro-inflammatory molecules.²⁷

The main function of IL-1 β and TNF- α is to trigger the innate inflammatory response and act as a co-stimulatory molecule of the immune response.³² Besides, TNF- α also plays an essential role in the tissue remodelling process after an injury, since it acts as an angiogenic factor and fibroblast growth factor.³³

The production of cytokines and inflammatory mediators, in association with the irritating effects of the elements resulting from hydrolysis through *C. acnes* action, attract inflammatory cells, which subsequently determine the rupture of the follicle through lysosomal action.³⁴ The production of cytokines by the ductal keratinocytes also seems to be relevant. Interleukin-1 alpha (IL-1 α), which induces comedogenesis, is present at high levels in many comedones.²³

Other mediators may be involved in hyperkeratinization.²⁷ *In vitro* models have shown the ability of the epidermal growth factor to rupture the comedo ducts, forming inflammatory acne lesions with the consequent activation of the nuclear transcription factor kappa B (NF- κ B), which is important for the positive regulation of many pro-inflammatory cytokines and cell proliferation genes.³⁵

Due to its importance in the expression of inflammatory genes, NF- κ B is a target for the treatment of various inflammatory diseases, and most anti-inflammatory agents have demonstrated to block the expression of inflammatory cytokines, inhibiting the activation via NF- κ B. It has been shown that the

inhibition of the production and biological activity of nitric oxide synthases (iNOS), cyclooxygenase-2 (COX-2), TNF- α and IL-1 β by selective inhibitors results in significant improvements in the development of several inflammatory diseases (Fig. 3).³⁶

As a result, TNF- α and IL-1 β are activated. These primary cytokines cause inflammation, acting on endothelial cells and preparing adhesion molecules, facilitating the recruitment of all inflammatory cells in the skin. TNF- α and IL-1 β can help to stimulate the proliferation of secondary cytokines, such as interleukin-8 (IL-8).³⁷

When they are activated by microbial ligands, the TLR produce an intracellular response that can lead to the translocation of NF- κ B, with the consequent modulation of the expression of immune response genes.³⁵

Researchers have reported that *C. acnes* has a soluble factor, which, in the presence of lymphocyte CD14 (a marker for monocyte populations), can activate TLR-2 and TLR-4¹⁷ and synthesize proinflammatory factors.³¹

Other studies have shown that, in response to the inflammation by *C. acnes*, human keratinocytes secrete beta-2 defensin (β D-2) and IL-8 and that these molecules are potent chemotactic factors of leukocytes and neutrophils infiltration, in addition to acting on the growth and differentiation potential of keratinocytes at the site of the *C. acnes* infection.³⁸ This evidence suggests that the maintenance of the inflammatory process of acne vulgaris is caused by *C. acnes*. The ideal treatment could, therefore, be a single product capable of suppressing the inflammatory response, reducing keratinization and the proliferation of *C. acnes*.^{11,39}

Hormonal Influence: Adjuvant Factor in the Etiopathogenesis of Acne Vulgaris

On the skin surface, the microbial community is mostly constituted by bacteria belonging to the three main genera of *Corynebacteria*, *Propionibacteria* and *Staphylococci*.⁴⁰ Interplay between members of this cutaneous microbiota at pilosebaceous unit is essential for the maintenance of a healthy skin.¹⁸

In addition to expressing androgen receptors, the sebaceous glands also have functional receptors for neuropeptides, such as the corticotropin-releasing hormone (CRH), melanocortins, β -endorphins, vasoactive intestinal peptides (VIP), neuropeptides γ (NP γ) and substance P. These receptors control the proliferation, differentiation and androgen metabolism of sebocytes, in addition to the production of cytokines and lipogenesis.⁴¹

DHT is the main androgen involved in the gland, positively stimulating its development and the production of sebum.⁴² Individuals with acne vulgaris usually have increased sebaceous glands that produce more sebum than individuals with healthy skin because the conversion rate of testosterone into DHT through the action of 5- α R is approximately thirty times greater in affected individuals (Fig. 4). However, the increase in the production of sebum in isolation is insufficient to explain the development of acne vulgaris.⁴³ The lipid composition of the sebum plays an important role in the pathogenesis of acne.²⁰ The levels of linoleic acid in the sebum of individuals with acne are known to be lower than those of individuals not affected by the pathology.

Deficiencies in linoleic acid, squalene and androgens have been implicated as causal factors of follicular hyperkeratinization and comedogenesis.^{44,45} Some studies, therefore, highlight the importance of

ROS as inflammatory mediators produced by phagocytes in the development of acne. Low levels of linoleic acid increase free radical production, so that superoxide dismutase (SOD) and catalase (CAT) decrease whereas xanthine oxidase (XO) and lipid peroxidation increase.⁴⁶

The presence of lipoperoxides in the sebum of individuals with acne is mainly due to the peroxidation of squalene and decreased levels of vitamin E, the predominant antioxidant in the sebum.⁴⁷ In conjunction with monounsaturated fatty acids (MUFAs), lipoperoxides are capable of generating inflammatory reactions, which start hyperkeratinization at the acroinfundibulum level of the pilosebaceous follicle.^{48,49}

Oxidative Stress in Acne Vulgaris

In normal physiological conditions, the skin has two endogenous defence systems against oxidative stress: antioxidant enzymes (CAT, SOD and glutathione peroxidase (GPX)) and non-enzymatic molecules (vitamin E, beta-carotene, ubiquinone and reduced glutathione (GSH)).⁵⁰⁻⁵² However, sometimes the endogenous defence system against ROS is insufficient.^{53,54}

When oxidizing species overcomes the skin's natural antioxidant system, the cellular redox imbalance leads to alterations in the cellular homeostasis and the generation of degenerative processes.⁵⁵ The oxidants produced by lipid peroxidation induce hyperkeratinization, increasing comedogenesis, forming advanced glycation end products through the formation of such byproducts as 4-hydroxy-2-nonenal and malondialdehyde (MDA), which may reticulate proteins and alter the rigidity of keratin, increasing follicular impaction. In addition, the lipid peroxides sensitize the walls of the follicles in the inflammatory response, making them more susceptible to rupture.²⁰

The implications of the impairment of the antioxidant defence system in inflammatory skin diseases were confirmed by a study that reported that N-acetyl-L-cysteine (NAC), known as the precursor of GSH, causes a negative regulation of interleukin-4 (IL-4), interleukin-5 (IL-5) and gamma interferon (INF- γ) in T-helper cells type-2 (Th2), with subsequent superactivation of the response in T-helper cells type-1 (Th1). This study also revealed that NAC works as a therapeutic agent in the treatment of diseases related to Th2.⁵⁶

The interaction between superoxide ($O_2^{\cdot-}$) and nitric oxide (NO) leads to the formation of highly reactive peroxynitrites ($ONOO^{\cdot-}$). In order to revert the overproduction of ROS, the skin activates antioxidant mechanisms such as SOD, which converts $O_2^{\cdot-}$ to hydrogen peroxide (H_2O_2), which is converted by CAT and GPx to water,⁵⁷ which is partially used for bactericidal action in polymorphonuclear leukocytes (PMN).⁵⁵

Two cytoplasmic enzymes, SOD and myeloperoxidase (MPO), protect the cell contents against oxidant activation.⁵⁵ SOD reduces both oxidative stress and the activation of inflammatory response mediators, while the GPx-GSH system performs the buffering of acute oxidative stress. The oxidative degeneration process of poly-unsaturated fatty acids known as lipid peroxidation induced by ROS leads to the formation of highly reactive aldehydes, such as MDA, which is related to damage to proteins, apoptosis or the release of pro-inflammatory mediators.⁵⁸

Previous studies have reported that the sebum components, particularly squalene, show an increased comedogenicity when they are oxidized, and oxidized squalene and its metabolites are found in much higher levels in patients with acne vulgaris than in healthy controls.⁴⁹

It has also been established that comedogenesis seems to be related to high levels of bioactive IL-1 α derived from the hyperkeratinocytes of the pilosebaceous unit.⁵⁹ When the oxidative damage blocks and alters the pilosebaceous unit, bacteria that colonize the site proliferate rapidly, producing toxins that irritate the skin. The immune system attacks the bacteria, and this increases the tissue inflammation exponentially.⁶⁰

Other studies have revealed that acne vulgaris is mediated by the increased generation of ROS, which can be attributed to low levels of antioxidant enzymes such as CAT, SOD, and total antioxidant capacity (TAC).⁵⁴ Lipidic peroxidation of fatty acids and unsaturated triterpenes like squalene generates intracellular and extracellular ROS.⁴⁸

The production of organic peroxides of squalene also reduces tissue levels of GSH and stimulates the production of inflammatory cytokines, positively regulating lipoxygenase (LOX) activity.⁴⁹ Another important discovery revealed that the activity of LOX and leukotriene B4 (LTB4) had been implicated in the promotion of inflammation in acne even in the absence of *C. acnes*. LTB4 is a chemoattractor capable of recruiting neutrophils, and its inhibition proved to reduce acne.^{61,62}

When the keratinocytes are exposed to *C. acnes*, the surface proteins immediately generate ROS, most notably O₂^{•-}. SOD converts O₂^{•-} into H₂O₂, and GPx then converts it into water. In this sense, SOD and GPx may undergo an intense reduction due to the oxidative stress load in the more severe forms of acne vulgaris.⁵⁵

CONCLUSION

The etiopathogenesis of acne vulgaris is multifactorial, and prior analysis of the possible causes is a determining factor for the adequate therapeutic choice.

Significant findings highlight that the initial factor is related to the oxidation of the sebum. Multifactorial events, like diet, stress, daily habits, age, genetics and hormones, generate conditions for the oxidation of the sebum. Squalene is one of the constituent fatty acids in the sebum. Despite its importance for the health of the skin, it is transformed into squalene hydrogen peroxide when it undergoes oxidative damage, which is potentially comedogenic. The oxidative breakdown of squalene and other lipids of the skin are not only consequences of the acne process but can be directly linked to the pathogenesis of acne. It is therefore believed that the inflammation of acne vulgaris is a secondary event to lipid peroxidation. That is, the equilibrium in the sebum components of the follicular unit may regulate and control the oxidative stress of the skin, avoiding the homeostatic imbalance of keratinization and sebaceous production, as well as sebaceous hyperplasia, conditions that can reduce bacterial colonization in the infundibulum, preventing tissue inflammation and possible formations of unaesthetic scars and characteristics.

Knowing the factors that promote acne, makes it possible to develop an effective treatment protocol for the clinical manifestations of acne vulgaris.

REFERENCES

1. Ahmad J, Gautam A, Komath S, Bano M, Garg A, Jain K. Topical Nano-emulgel for Skin Disorders: Formulation Approach and Characterization. Recent Pat Antiinfect Drug Discov. 2018;14(1):36–48.

2. Dréno, B., Pécastaings, S., Corvec, S., Veraldi, S., Khammari, A., Roques C. Cutibacterium acnes (Propionibacterium acnes) and acne vulgaris : a brief look at the latest updates. 2018;32:5–14.
3. Lertsatitthanakorn P, Taweechaisupapong S, Aromdee C, Khunkitti W. In vitro bioactivities of essential oils used for acne control. Int J Aromather. 2006;16(1):43–9.
4. Habeshian KA, Cohen BA. Current Issues in the Treatment of Acne Vulgaris. Pediatrics. 2020;145(Supplement 2):S225–30.
5. Hsieh MF, Chen CH. Review: Delivery of pharmaceutical agents to treat acne vulgaris: Current status and perspectives. J Med Biol Eng. 2012;32(4):215–24.
6. STEWART, T. J.; BAZERGY, C. Hormonal and dietary factors in acne vulgaris versus controls. Dermato-Endocrinology, v. 10, n. 1, p. 1–4, 2018.
7. Halvorsen JA, Lien L, Dalgard F, Bjertness E, Stern RS. Suicidal ideation, mental health problems, and social function in adolescents with eczema: A population-based study. J Invest Dermatol [Internet]. 2014;134(7):1847–54. Available at: <http://dx.doi.org/10.1038/jid.2014.70>
8. Samuels D V., Rosenthal R, Lin R, Chaudhari S, Natsuaki MN. Acne vulgaris and risk of depression and anxiety: A meta-analytic review. J Am Acad Dermatol [Internet]. 2020; Available at: <https://doi.org/10.1016/j.jaad.2020.02.040>
9. Tasoula E, Gregoriou S, Chalikias J, Lazarou D, Danopoulou I, Katsambas A, et al. The impact of acne vulgaris on quality of life and psychic health in young adolescents in Greece: results of a population survey. An Bras Dermatol. 2012;87(6):862–9.
10. Isaacsson VCS, Duquia RP, de Souza PRM, de Almeida HL, Breunig J de A. Dissatisfaction and acne vulgaris in male adolescents and associated factors. An Bras Dermatol. 2014;89(4):576–9.
11. Jorgaqi E, Savo I, Koraqi A, Doci X, Cela R, Vasili E, et al. Efficacy of acne vulgaris treatment protocols according to its clinical forms. Dermatol Ther. 2020;(May).
12. Sandru F et al. Treatment of acne vulgaris in relation to its etiopathogenesis. Rom J Med Pract. 2019;14(4):407–12.
13. Costa A, Michalany NS, Alchorne MMA, Lima HC. Acne vulgar: Estudo piloto de avaliação do uso oral de ácidos graxos essenciais por meio de análises clínica, digital e histopatológica. An Bras Dermatol. 2007;82(2):129–34.
14. Lages RB, Bona SH, Silva FVM e, Gomes AKL, Campelo V. Acne fulminans successfully treated with prednisone and dapsone. An Bras Dermatol. 2012;87(4):612–4.
15. Gollnick HP, Bettoli V, Lambert J, Araviiskaia E, Binic I, Dessinioti C, et al. A consensus-based practical and daily guide for the treatment of acne patients. J Eur Acad Dermatology Venereol. 2016;30(9):1480–90.
16. Holland DB, Jeremy AHT. The role of inflammation in the pathogenesis of acne and acne scarring. Semin Cutan Med Surg. 2005;24(2):79–83.
17. Costa a., Alchorne MM a., Goldschmidt MCB. Etiopathogenic features of acne vulgaris. An Bras Dermatol [Internet]. 2008;83(5):451–459. Available at: http://www.scielo.br/scielo.php?pid=S0365-05962008000500010&script=sci_arttext&tlng=es
18. Dessinioti C, Dreno B. Acne treatments: future trajectories. Clin Exp Dermatol. 2020;(March):1–7.

19. Spagnolo E, Jéssica RM, Ceratti C, Spagnolo F, Adriana M, Asta D, et al. Efeitos da ação dos ácidos graxos na pele sadia por biometria cutânea * Action effects of fatty acids in healthy skin by skin biometry *. 2017;48–54.
20. Mills OH, Criscito MC, Schlesinger TE, Verdicchio R, Szoke E. in *Acne Vulgaris*. 2016;9(1):25–30.
21. Costa A, Lage D, Moisés TA. Acne and diet: truth or myth? *An Bras Dermatol*. 2010;85(3):346–53.
22. John R.Giudicessi, BA.Michael J.Ackerman. 2013. 基因的改变 NIH Public Access. Bone [Internet]. 2008;23(1):1–7. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3624763/pdf/nihms412728.pdf>
23. Jones SA, Horiuchi S, Topley N, Yamamoto N, Fuller GM. The soluble interleukin 6 receptor: Mechanisms of production and implications in disease. *FASEB J*. 2001;15(1):43–58.
24. Alibardi L, Maderson PFA. Distribution of Keratin and Associated Proteins in the Epidermis of Monotreme , Marsupial , and Placental Mammals. 2003;66:49–66.
25. Jarrousse V, Castex-Rizzi N, Khammari A, Charveron M, Dréno B. Modulation of integrins and filaggrin expression by *Propionibacterium acnes* extracts on keratinocytes. *Arch Dermatol Res*. 2007;299(9):441–7.
26. Cappel M, Mauger D, Thiboutot D. Correlation between serum levels of insulin-like growth factor 1, dehydroepiandrosterone sulfate, and dihydrotestosterone and acne lesion counts in adult women. *Arch Dermatol*. 2005;141(3):333–8.
27. Ryu S, Han HM, Song PI, Armstrong CA, Park Y. Suppression of *propionibacterium acnes* infection and the associated inflammatory response by the antimicrobial peptide P5 in Mice. *PLoS One*. 2015;10(7):1–18.
28. Vaz AL. Acne vulgar: Bases para o seu tratamento. *Rev Port Med Geral e Fam* [Internet]. 2003;19(6):561–70. Available at: [http://www.rpmgf.pt/ojs/index.php?journal=rpmgf&page=article&op=view&path\[\]=9989](http://www.rpmgf.pt/ojs/index.php?journal=rpmgf&page=article&op=view&path[]=9989)
29. Bradley PP, Priebe D a, Christensen RD, Rothstein G. Measurement of cutaneous inflammation: estimation of neutrophil content with an enzyme marker. Vol. 78, *The Journal of investigative dermatology*. 1982. p. 206–9.
30. Koreck A, Pivarsci A, Dobozy A, Kemény L. The role of innate immunity in the pathogenesis of acne. *Dermatology*. 2003;206(2):96–105.
31. Kim J, Ochoa M-T, Krutzik SR, Takeuchi O, Uematsu S, Legaspi AJ, et al. Activation of Toll-Like Receptor 2 in Acne Triggers Inflammatory Cytokine Responses. *J Immunol*. 2002;169(3):1535–41.
32. Uchi H, Terao H, Koga T, Furue M. Cytokines and chemokines in the epidermis. *J Dermatol Sci*. 2000;24(SUPPL. 1):29–38.
33. Campos ACL, Borges-branco A, Groth AK. Wound healing. *Arq Bras Cir Dig* [Internet]. 2007;20(1):51–8. Available at: <http://www.scielo.br/pdf/abcd/v20n1/10.pdf>
34. Shi VY, Leo M, Hassoun L, Chahal DS, Maibach HI, Sivamani RK. Role of sebaceous glands in inflammatory dermatoses. *J Am Acad Dermatol* [Internet]. 2015;73(5):856–63. Available at: <http://dx.doi.org/10.1016/j.jaad.2015.08.015>
35. McInturff JE, Kim J. The role of toll-like receptors in the pathophysiology of acne. *Semin Cutan*

- Med Surg. 2005;24(2):73–8.
36. Saleem M, Afaq F, Adhami VM, Mukhtar H. Lupeol modulates NF- κ B and PI3K/Akt pathways and inhibits skin cancer in CD-1 mice. *Oncogene*. 2004;23(30):5203–14.
 37. Auffret N. Pathophysiological advances in acne. *Ann Dermatol Venereol* [Internet]. 2010;137(SUPPL. 2):S52–6. Available at: [http://dx.doi.org/10.1016/S0151-9638\(10\)70025-9](http://dx.doi.org/10.1016/S0151-9638(10)70025-9)
 38. Nagy I, Pivarsci A, Kis K, Koreck A, Bodai L, McDowell A, et al. Propionibacterium acnes and lipopolysaccharide induce the expression of antimicrobial peptides and proinflammatory cytokines/chemokines in human sebocytes. *Microbes Infect*. 2006;8(8):2195–205.
 39. Fan E, Zhang L, Jiang S, Bai Y. Beneficial effects of resveratrol on atherosclerosis. *J Med Food*. 2008;11(4):610–4.
 40. Grice EA, Kong HH, Conlan S, Deming CB, Davis J, Young AC, et al. Topographical and temporal diversity of the human skin microbiome. Grice, E. A., Kong, H. H., Conlan, S., Deming, C. B., Davis, J., Young, A. C., ... Segre, J. A. (2009). Topographical and temporal diversity of the human skin microbiome. *Science* (New York, N. Science [Internet]. 2009;324(5931):1190–2. Available at: <http://www.sciencemag.org.libproxy.mit.edu/content/324/5931/1190.full>
 41. Kurokawa I, Danby FW, Ju Q, Wang X, Xiang LF, Xia L, et al. New developments in our understanding of acne pathogenesis and treatment. *Exp Dermatol*. 2009;18(10):821–32.
 42. Gallitano SM, Berson DS. How Acne Bumps Cause the Blues: The Influence of Acne Vulgaris on Self-Esteem. *Int J Women's Dermatology* [Internet]. 2018;4(1):12–7. Available at: <https://doi.org/10.1016/j.ijwd.2017.10.004>
 43. Neto EMR, Bruna K, Torres N, Junior FJG. Abordagem terapêutica da acne na clínica farmacêutica Therapeutic approach of acne in pharmaceutical clinic. 2015;59–66.
 44. Nakatsuji T, Kao MC, Fang J, Zouboulis CC, Gallo RL, Huang C. NIH Public Access. October. 2009;129(10):2480–8.
 45. Sarici G, Cinar S, Armutcu F, Alt C, Koca R, Tekin NS. Oxidative stress in acne vulgaris. 2010;763–7.
 46. Morganti P, Berardesca E, Guarneri B, Guarneri F, Fabrizi G, Palombo P, et al. Topical clindamycin 1% vs. linoleic acid-rich phosphatidylcholine and nicotinamide 4% in the treatment of acne: A multicentre-randomized trial. *Int J Cosmet Sci*. 2011;33(5):467–76.
 47. Ig OR, Ar I. Antioxidant activity , lipid peroxidation and skin diseases . What ' s new. 2003;663–9.
 48. Ottaviani M, Camera E, Picardo M. Lipid mediators in acne. *Mediators Inflamm*. 2010;2010.
 49. Ottaviani M, Alestas T, Flori E, Mastrofrancesco A, Zouboulis CC, Picardo M. Peroxidated squalene induces the production of inflammatory mediators in HaCaT keratinocytes: A possible role in acne vulgaris. *J Invest Dermatol*. 2006;126(11):2430–7.
 50. dos Santos ZMQ, dos Santos MQ, Zancanaro V, Bellaver EH, Nardi GM, Gelinski JML, et al. Topical application of phenolic compounds suppresses Propionibacterium acnes-induced inflammatory responses in mice with ear edema. *Naunyn Schmiedebergs Arch Pharmacol*. 2019;392(5):529–40.
 51. Arican O, Kurutas EB, Sasmaz S. Oxidative stress in patients with acne vulgaris. *Mediators Inflamm*. 2005;2005(6):380–4.

52. Matar A, EL Samahy M, Hassen S, EL-Khazragy N. Effect of Intense Pulsed Light on Oxidative Stress in Acne Vulgaris. *J Recent Adv Med*. 2020;1(1):14–9.
53. Bickers DR, Athar M. Oxidative stress in the pathogenesis of skin disease. *J Invest Dermatol* [Internet]. 2006;126(12):2565–75. Available at: <http://dx.doi.org/10.1038/sj.jid.5700340>
54. Al-shobaili HA. Oxidants and Anti-Oxidants Status in Acne Vulgaris Patients with Varying Severity. 2014;44(2):202–7.
55. Grange PA, Chéreau C, Ringeaud J, Nicco C, Weill B, Dupin N, et al. Production of superoxide anions by keratinocytes initiates *P. acnes*-induced inflammation of the skin. *PLoS Pathog*. 2009;5(7).
56. Bengtsson, Lundberg M, Avila-Cariño J, Jacobsson G, Holmgren A, Scheynius A. Thiols decrease cytokine levels and down-regulate the expression of CD30 on human allergen-specific T helper (Th) 0 and Th2 cells. *Clin Exp Immunol*. 2001;123(3):350–60.
57. Fridovich I. Fundamental aspects of reactive oxygen species, or what's the matter with oxygen? *Ann N Y Acad Sci*. 1999;893:13–8.
58. Kurutas EB, Arican O, Sasmaz S. Superoxide dismutase and myeloperoxidase activities in polymorphonuclear leukocytes in acne vulgaris. *Acta Dermatovenereologica Alpina, Pannonica Adriat*. 2005;14(2):39–42.
59. Eady E a, Cove JH. Is acne an infection of blocked pilosebaceous follicles? Implications for antimicrobial treatment. *Am J Clin Dermatol*. 2000;1(4):201–9.
60. Ikeno H, Tochio T, Tanaka H, Nakata S. Decrease in glutathione may be involved in pathogenesis of acne vulgaris. *J Cosmet Dermatol*. 2011;10(3):240–4.
61. Zouboulis CC. Zileuton, a new efficient and safe systemic anti-acne drug. *Dermatoendocrinol*. 2009;1(3):188–92.
62. Zouboulis CC, Seltmann H, Alestas T. Zileuton prevents the activation of the leukotriene pathway and reduces sebaceous lipogenesis. *Exp Dermatol*. 2010;19(2):148–50.
63. Ribeiro B de M, Almeida LMC, Costa A, Francesconi F, Follador I, Neves JR. Etiopathogeny of acne vulgaris: a practical review for day-to-day dermatologic practice. *Surg Cosmet Dermatology*. 2015;7(3):20–6.
64. Degitz K, Placzek M, Borelli C, Plewig G. Pathophysiologie der akne. *JDDG - J Ger Soc Dermatology*. 2007;5(4):316–25.

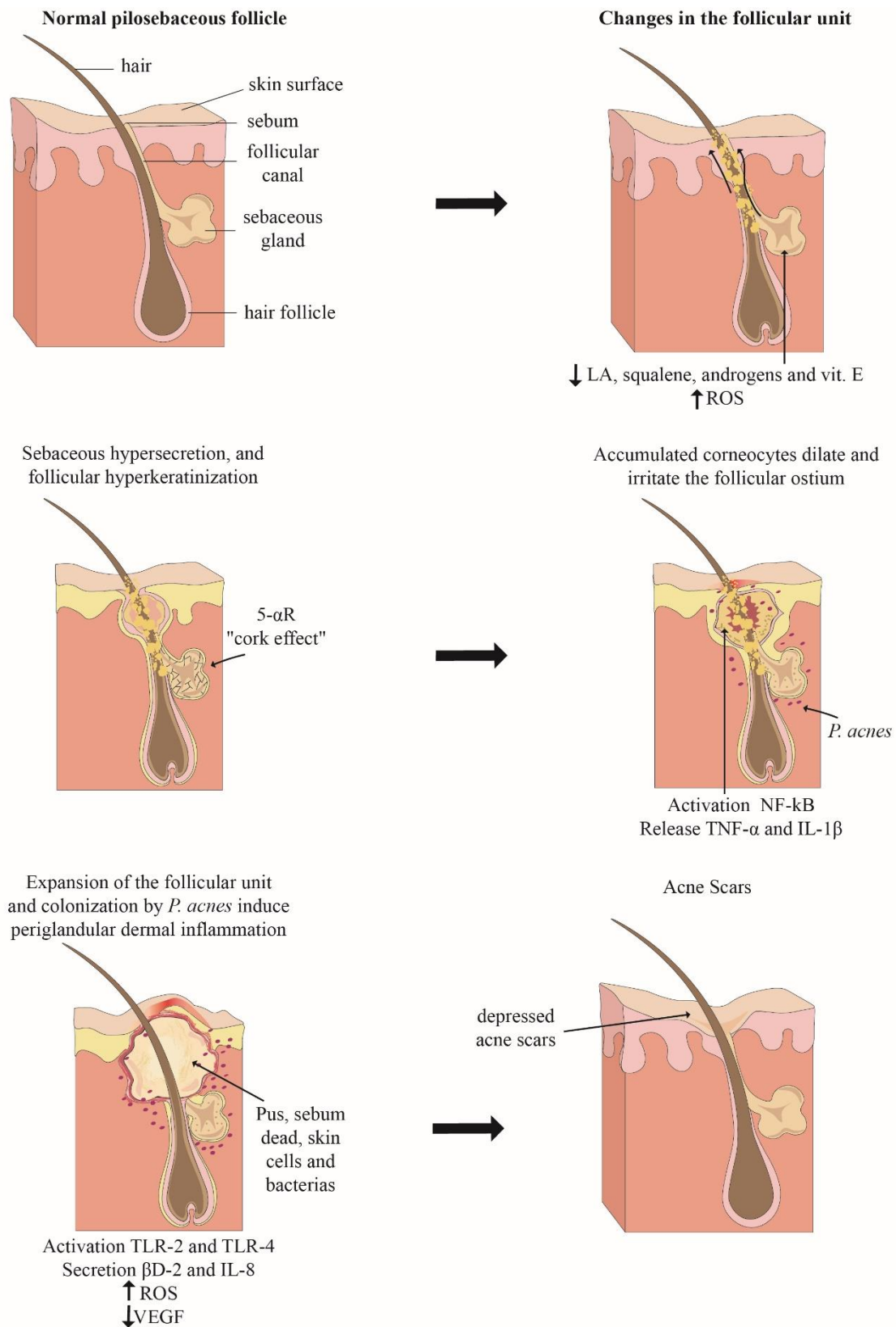
Figure 1

Figure 2

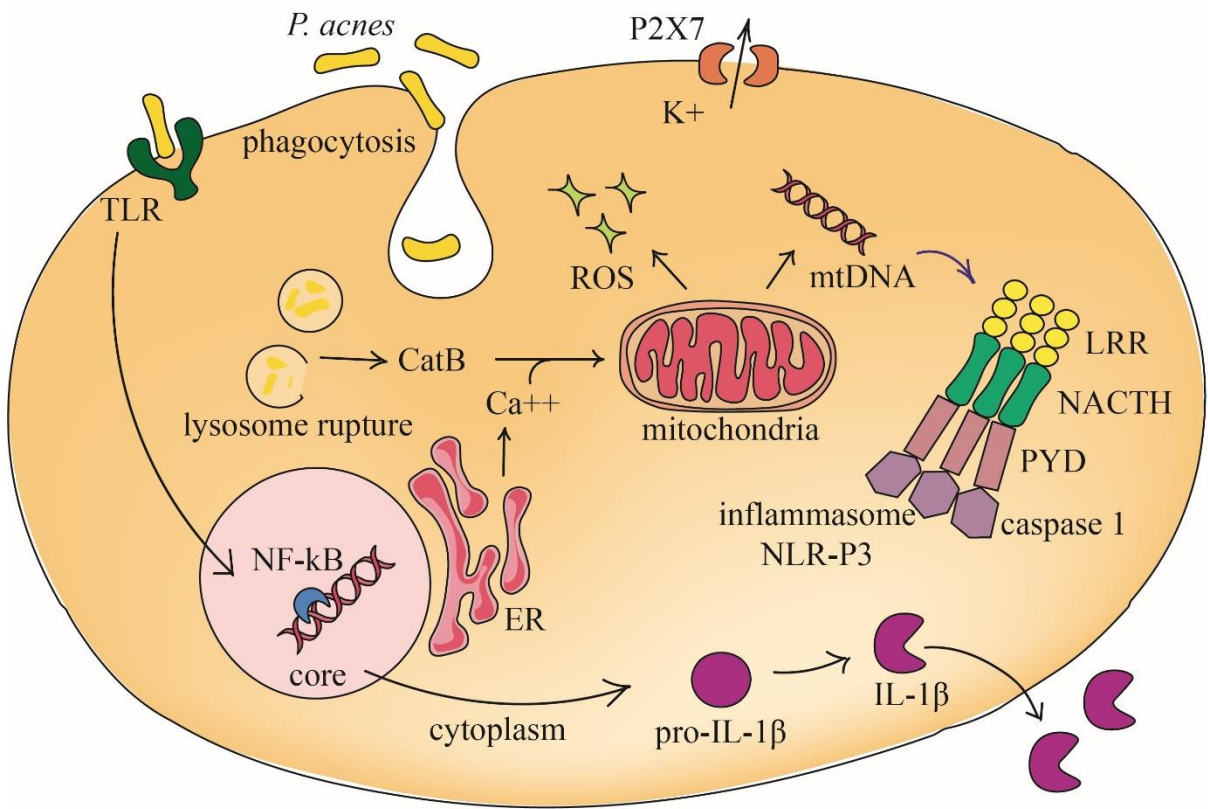


Figure 3

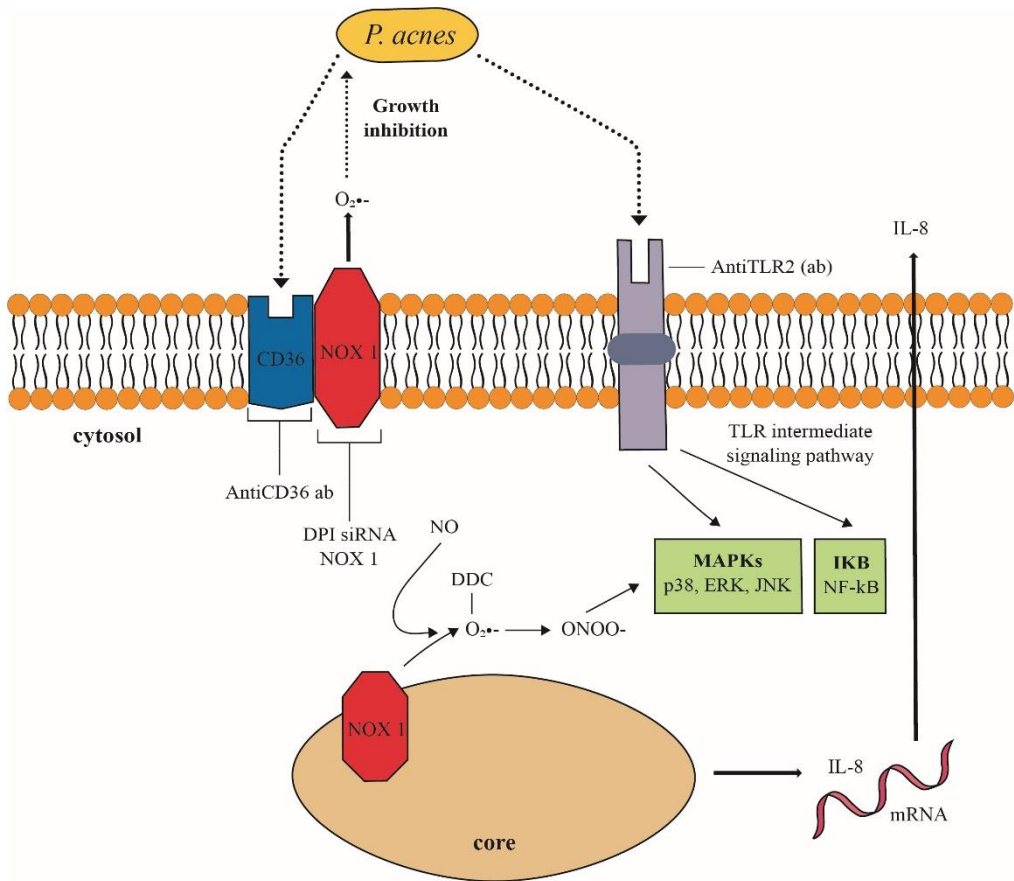
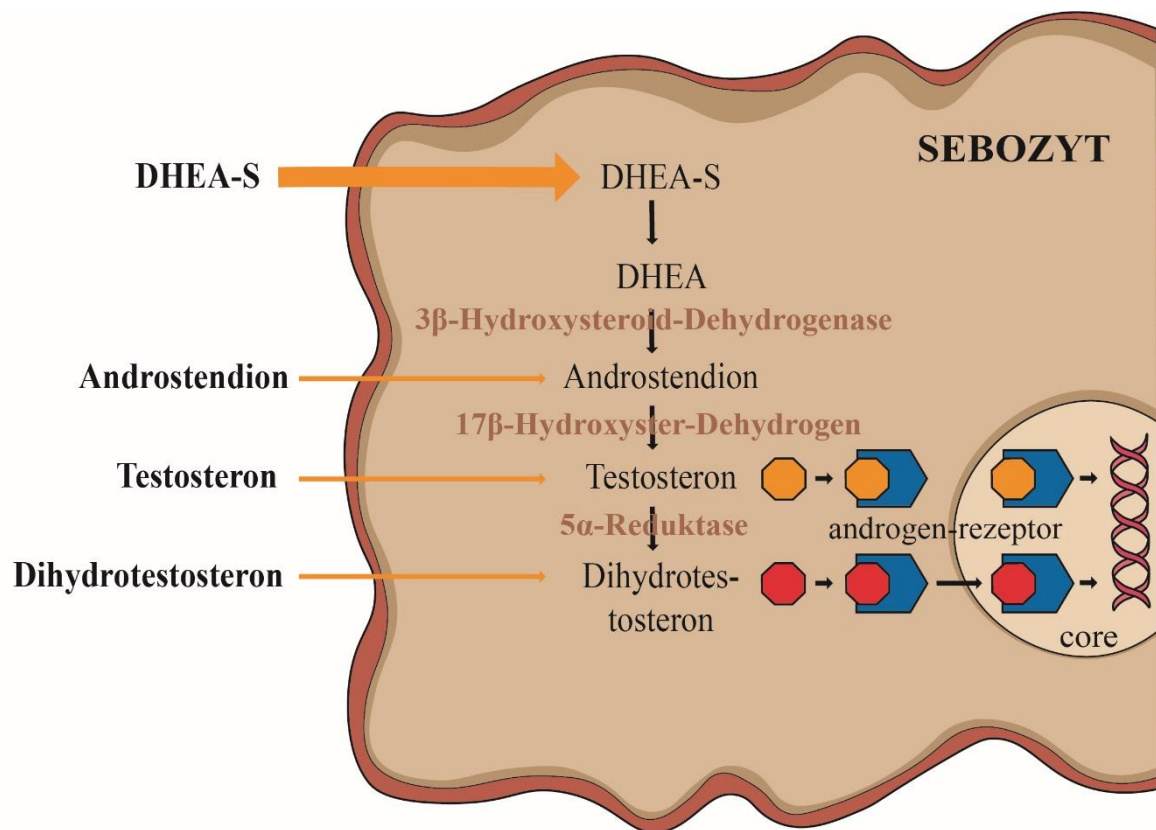


Figure 4

Legends to figures:

Figure 1 Schematic of the formation of acne vulgaris: the healthy pilosebaceous follicle undergoes changes in the follicular unit.

Source: Authors.

Figure 2 Schematic representation of *C. acnes* in contact with cells of myeloid origin, producing a sequence of molecular events.

Source: Adapted from Ribeiro et al. (2015).⁽⁶³⁾

Figure 3 Receptors of the subpopulation expressed in platelets, monocytes and macrophages (CD36) and TLR-2 recognize *C. acnes*.

Source: Adapted from Grange et al. (2009).⁽⁵⁵⁾

Figure 4 Dehydroepiandrosterone sulfate regulates the primary production of sebum.

Source: Adapted from Degitz et al. (2007).⁽⁶⁴⁾

Youths and their future perspectives: a systematization of experiences

Me. Luís Eurico Kerber (Corresponding author)

Programa de Pós-graduação Stricto Sensu em Diversidade Cultural e Inclusão Social
Novo Hamburgo, Rio Grande do Sul, Brasil.

Dra. Dinora Tereza Zucchetti

Programa de Pós-graduação Stricto Sensu em Diversidade Cultural e Inclusão Social
Novo Hamburgo, Rio Grande do Sul, Brasil.

Esp. Tatiane de Oliveira

Grupo de pesquisa e extensão: Estudos, Pesquisas e Práticas em Educação Não Escolar
Novo Hamburgo, Rio Grande do Sul, Brasil

Corresponding author

Complete address: Padre Nóbrega Street, 201 apartment 202, Novo Hamburgo, Rio Grande do Sul,
Brazil, ZIP code 93525-290

Telephone: +55 51 984519171

E-mail address: luislek@feevale.br

Abstract

This text was written from a workshop with young people from the city of Novo Hamburgo in the state of Rio Grande do Sul. We problematized the youths and their perspectives of future in an interface of education and work. The study uses the methodology of systematization of experiences to analyze the practices with eight young people in the workshop "Young People in Action" by approaching the themes: future, education and work and thus identify which elements are determinant for creating expectations for the future. The theoretical framework has an important contribution from popular education and sociology. We found that: the school and the family are structural tests that circumscribe the future expectations of young people; the young ones also presented dissonance in their tendencies as to what believe or act and they do not seem to have the habit of making plans about the future. The systematization of experiences showed to be very powerful, since it allows a constant movement of teaching and learning through practice.

Keywords: Future, Youth, Experience Systematization.

1. Introduction

The study uses the systematization of experiences as methodological basis to think about practices with young people and from them produce knowledge (FALKEMBACH, 2007). It allows, by

reconstructing the process, to identify, classify, and reorder its elements, making it possible to aim at the lived experience, in a movement of distancing from what we experience and, thus, to convert one's own experience into an object of study and theoretical interpretation and, at the same time, into an object of transformation (HOLLIDAY, 2006).

In this sense, we systematized experiences with young people in the context of the workshop "Youth in Action", which is consisted of a project of non-school education in the social field. We understand as non-school education those educational practices, mostly, led by socio-assistance entities that have emerged in Brazil in the last decades and that compose, along with social movements, community education and popular education, leading to an educational perspective with a view to the formation of citizenship (ZUCCHETTI; MOURA; LACERDA, 2019).

So, we defend that non-school education practices are alternative pedagogical strategies that, to some extent, can make a stand against the processes of social exclusion of children, teens and young people by constituting social practices with the intent to produce new knowledge (ZUCCHETTI; MOURA; LACERDA, 2019). In this perspective, by systematizing the workshop with young people we aimed to identify which elements in the juvenile trajectories are determinant for the creation of their future perspectives. In order to do so, meetings that addressed the themes future, education and work were systematized.

A hybridization between future, education and work are present in the studies of researchers who were dedicated to investigating youth, especially those arisen from the popular classes: Pais (2016); Dayrell (2007); Leão, Dayrell and Reis (2011a, 2011b), Dayrell and Jesus (2016); Andrade (2017); Souza and Silva (2018), Silva and Leme (2019). Their ideas converge by indicating that the school appears in juvenile narratives as an imperative factor for a better future.

According to Pais (2016) the future is the time that seems to legitimize the education system by predicting that it allows the "formation of the future men of tomorrow". Yet in the labyrinth of life, the impasses of the present make the future absent and obstacles make choices difficult.

2. The systematization process of the workshop “Young People in Action”

The workshop "Youth in Action" is one of the strategies of the Community and Bond Strengthening Service (CBSS – acronym in Portuguese SCFV¹) within the scope of the Social Assistance policy. It was planned after we have noticed that once they turned 15 and had disconnect from the daily care offered by the SCFV, these same young people wouldn't engage in any other educational activities; some of them were drop outs who weren't old enough to enter the job market - except as an apprentice². Therefore, due to this idle condition, they would become more and more vulnerable to the risks of the territory; it's not a surprise that most of the crimes committed by young people occur in their free time (PAIS, 2016). For

¹ ¹The SCFV is a basic social protection service of the Unified Social Assistance System which acts along with the Service of Protection and Integral Care to Families and the Service of Protection and Specialized Care to Families and Individuals. It has a preventive and proactive character, based on the defense and consolidation of rights and on the development of users' capacities and potentialities, aiming at their emancipation to face social vulnerabilities (BRASIL, 2017).

² Learning Law No. 10,097/2000 provides young people aged 14 to 18 years with methodical technical-professional training compatible with their physical, moral, and psychological development.

Castel (1997) a person is considered to be in the zone of vulnerability when their working conditions are precarious or non-existent and the relational support is weakened.

In this regard, the workshop was developed with the objective of strengthen family and community life; value youth plurality; provide speech and listening space; contribute to the permanence or return of young dropouts to school and encourage their participation in decision-making spaces which discuss youth-related topics. Participants were eight young people from 15 to 18 years old, active students or dropout students of elementary school, who henceforth will be mentioned according to the table below:

Table 1: Young participants Characterization and Scholarity

Codename	Age	Scholarity
Alice	18 years	8th grade – dropped out studies
Ana	15 years	7th grade – in school
Vitória	15 years	8th grade –in school–under Institutional sheltering
Raquel	15 years	4th grade – in school–under Institutional sheltering
Davi	17 years	7th grade – dropped out studies
Kevin	15 years	7th grade – dropped out studies
Jonas	18 years	7th grade – dropped out studies
Wesley	15 years	7th grade - night school

Source: Authors

That said, fourteen meetings were held with weekly periodicity and duration of 1 hour and 30 minutes, from September to December 2019, whose preferred themes were: juvenile identities; community life; future; education; work; mental health; sexuality; drugs.

The devices used to record the experiences during the workshop were: learning recovery form, recorded and later transcribed interviews were registered in a Field Journal, which were instruments that added quality to the analysis of the produced materials.

We explained that the learning recovery form is a tool born from the systematization of their experiences that intends to "recover lessons from significant moments to set up a learning information bank" (HOLLIDAY, 2007, p. 27). It must contain the context of the situation; a report of what happened; learning strategies; recommendations to other spaces they are inserted or would like to develop similar experience and keywords (HOLLIDAY, 2007).

Therefore, considering the methodological approach described, the considerations about the study will follow the actions developed in the workshop. It was by looking at the present and planning the future that these young people were able to pinpoint education and work as fundamental elements for the achievement of a better life.

3. Education and Work: what young people think about the future

When it comes down to talking about youths, sayings like "They don't think about the future", "They just want to live today", and "They aren't committed to anything" sound natural and place young people as the only ones responsible for their destiny when adopting an adult-centered perspective.

Nevertheless, those who work with youths and are willing to listen to them know that this is not the reality: in the speech of young people, in general, education appears as a condition to conquer a career and become someone in life, as if in the current reality, they were nobodies. This thought is a byproduct from the imaginary of those coming from average to low-income layers of society, who strongly believe in education as the only path for social elevation. However, it is known that in Brazil the lowest levels of education are among the poorest levels of the population, which directly implies the jobs they will occupy.

With this in mind, even after presenting several points to believe that education and work are imperative for a better future, young people seem to struggle to develop any perspectives of change in their social field due to their poor life conditions (LIMA, 2013). Therefore, they live a time of instability and uncertainty, with a great deal of tension between the present and the future, where life looks more and more like a spinning yo-yo (PAIS, 2016). In view of this, similar to the yo-yo-like trajectories of young people, this study will also be presented cyclically with back and forth movements in which education and work represent points of arrival and departure in the race for the future.

3.1 The future

Talking about a life and future project for young people who thrive to survive is a big challenge. They must choose between either the ethics of the cicada or the ant. In the first case, if one enjoys the present, they sacrifice the possibility of conquering a successful welfare in the future. In the second case, the present pleasure is sacrificed in exchange for success in the future. (PAIS, 2016).

According to Leão, Dayrell and Reis (2011a), inspired by Schultz (1979), a life project consists in the action of the individual to choose one, among several possible futures, by turning dreams and fantasies into goals to be pursued. Andrade's study (2017), in turn, addresses juvenile narratives about future and education. In the section entitled "What to do next year?" the researcher found different narratives among youngsters with points in common, such as the difficulty of making decisions and planning the future. In addition to it, the school once again was mentioned as being imperative, which allows us to defend that the elaboration of a life project is closely related to the field of possibilities given by the socioeconomic and cultural context in which these youngsters are inserted.

For Velho (1994) the field of possibilities refers to the set of alternatives built through the socio-historical process, which go through the interpretative potential of the symbolic world of culture. From this perspective, Individual projects always interact with others within a field of possibilities. They do not operate in a vacuum, but from premises and cultural paradigms shared by specific universes. Therefore, they are complex and individuals, at first, can be bearers of different, even contradictory projects (VELHO, 1994, p. 46).

Moreover, in the workshop "Youth in Action", in one of the activities in which students should develop an Individual Development Plan with small objectives to be achieved between September and December 2019, the difficulties in planning their future were evidenced. Among the questions to be answered was the following: "Do you usually plan your activities? Do you make plans for the future? Explain them." The answers pointed out different ways of looking at the future. For Raquel and Vitória the plans for the future depended much more on institutional decisions than on their ambitions, because both were in an institutional sheltering situation. Anyway, their plan was to return to their families. The other youngsters

said: "Yes (I do plan). My plan this year is to be champion of the Sulicampe Cup³" (DAVID, 2019). "I don't plan anything, because I just don't think about the future" (KEVIN, 2019). "I like to plan to motivate myself" (JONAS, 2019). "I don't plan because I'm lazy" (ALICE, 2019). "I don't usually plan, because I don't have time for it" (ANA, 2019). The answers - if analyzed outside a broader context - indicate that young people do not usually plan for the future. However, when answering the question "At the beginning of 2019, what was your main goal?" they pointed the school and work as important conditions for the future, with school year approval being the main objective, which to some extent represents a way of planning.

Andrade (2017) states that the school plays a role in our social environment as an important institution for the transformation of individuals and societies. This discourse ends up becoming part of common sense, and what is said in common sense does not constitute a discursive totality. It became clear in the narratives of the studied subjects. In the question "Have you abandoned any goals set for the year 2019?" Kevin, Jonas, David and Alice stated that the school was an abandoned goal in 2019. In other words, perhaps the same speech that attributes importance to education comes from common sense and is reproduced among them. The young people were unanimous in answering that they did not achieve their goals because they did not try hard enough. However, some reports revealed other important elements worth some reflection on. Kevin, when mentioned dropping out of school, stated that "At first I think I struggled, but then I slacked and let idleness take over me. Besides, there was the anxiety of being around other people and so I gave up." According to Jonas he did not try hard enough and took the blame for dropping out but stated that "other problems that happened" also interfered. But in addition to the distance between discourse and practice, the systematization process sought to identify the reasons why some objectives were lost during the course, which made understanding the relationship established between young people and school an essential factor to be uncovered.

3.2 Education

As previously seen, the young participants of the workshop believe that schooling is fundamental to achieve a better future. Nevertheless, they remain at the edge of the educational field by either dropping it out or flunking.

In addition to it, the studies of Leão, Dayrell and Reis (2011a; 2011b), Dayrell (2007), Silva and Leme (2019) reveal that work and education are also important elements in juvenile narratives. However, the research data indicate that many young people were out of school, unemployed or in underemployment and that among the popular classes less than 40% were able to complete high school at the appropriate age (SILVA; LEME, 2019).

A study published by Getúlio Vargas Foundation (2019) made a very interesting diagnosis about the labor and educational evolution of young people between 15 and 29 years old. The research indicated that in 2019, 26.19% of young people only studied; 37.79% only worked; 11.60% worked and studied and 24.53% belonged to the "NEET" group; they neither studied nor worked. In the context of this study, among the eight young participants of the workshop half belonged to the "NEET" group, the rest only studied.

³ Super Liga de Campeonatos e Eventos Esportivos - SULICAMPE organizes football championships in Rio Grande do Sul. The championship mentioned by the young man was called Gauchinho Paranhana, in which they were runners-up.

Though they attended elementary school, they were old enough to be in high school.

Thus, between discursive contradictions and objective practices, young people have maintained a strong orientation towards the present since the future fails to offer possibilities to realize the aspirations that are drawn in relation to it and thus the projects of the future remain relatively absent (PAIS, 2016). In view of the above, it is important to think that the individual or collective projects we build represent, in a certain way, an essential resource to deal with reality by acting as an escape valve for their problems. However, when we think of the Brazilian reality, which is known for its deep inequalities, it's possible to state that certain segments of the population face challenges when elaborating their future projects due to their restricted possibilities and limited alternatives of choice (SILVA; LEME, 2019).

Hence, seeking to understand what space education occupies in youth future projects, we use as a trigger for the debate the documentary "Never dreamed of me" that deals with the challenges of the present, expectations for the future and the dreams of young people who live the reality of public high schools in Brazil. The youth were attentive to every detail of the video. They were touched by difficult realities; identified themselves with youth vocabulary; became thoughtful of the uncertainties that also had overwhelmed the young ones in the documentary. After watching it, we gathered in a circle for a debate in which the youngsters did not talk much. They said they liked the documentary very much, but they did not move forward with the discussion. Ana was a bit more participative and contributed by saying that "the school has some good moments such as the lunch time and the coexistence with classmates". She said that there are teachers who do not care much about students, but that also there are those who make a difference.

Similarly, in the studies by Silva and Leme (2019) and Andrade (2017) young people, when reporting their experiences with school, seem to refer to it as a place of sociability. Moreover, they point to the teacher as an important figure in the schooling process. In this same research, one of the interviewed youngsters stated that with teachers who just taught because they had to and not because they wanted to the construction of a bond of trust and closeness was difficult and therefore they couldn't talk to them about what they aspired to the future (SILVA; LEME, 2019).

In this perspective, given the low participation of young people in the debate, we concluded that the planning needed to be reviewed. The silence is revealing and at that moment indicated that perhaps the oral form was not the most appropriate to establish a relationship of trust that would allow reflection on the content of the video. So, at the next meeting it was proposed that they should write a letter to the school. They soon questioned whether it would be handed over to the institution. We explained that it would not and that it did not have to be signed. The objective was to think of the school as a person and tell them how they felt about this student-school relationship. Each of them took a sheet of paper and a pencil and searched a corner of the room to write. They stayed there for about 40 minutes. Alone, in silence. Some scratched their heads; others gnawed their nails while their eyes went far away engulfed in their thoughts.

After completing the writing, they delivered the letters. The content of them provided significant elements to reflect on the historical construction of the school along with its times, spaces, functions and transformations. Kevin's letter reminds us of what Foucault (1987) presents in his work "Watch and Punish". "Dear school, I wanted to tell you through this letter that I never really felt like a student, I felt like a prisoner who was bound to be there. I didn't feel like being there, because I basically just listened and took notes in my notebook and didn't learn anything "(KEVIN, 2019).

The young man compares himself to a prisoner forced to remain in a space in which his body does not feel at ease and discipline requires that listening and copying happen in the order of a given time. The interpretation of Kevin's letter seems to describe the 18th-century school and its new contours. The ordination of students in rows in the room as well as in the courtyard and in the corridors; the organization of classes according to levels; the groups of students aligned under the master's gaze and the control of activities by schedules allowed a new management of learning time and turned the school space into a machine used not only for teaching but also for watching, hierarchizing and rewarding (FOUCAULT, 1987). Therefore, it seems necessary to reflect that even after more than two centuries of the description of school in Foucault's work, its architecture and organization of the panopticon remains very current.

However, even playing the role of monitoring, punishing and disciplining subjects so that after becoming docile they can be useful (FOUCAULT, 1987), the school can be an important equipment in the social protection network, which has the teacher and the school environment as an intervener in the juvenile trajectories. For Ana the school represents some sort of refuge:

I feel that the school needs to welcome us, the young ones, the teenagers, the children. We need, we crave for sensitivity, we need understanding. Do I sometimes reflect on what I am going to do at school? I often feel like school is a refuge from the problems, the difficulties I have to endure outside of it. Teachers are very important. I feel so engaged when the teacher enters the room, joins us in our talk and explains the topics with fun, with love. It motivates me, makes me want to go to school. I often do not feel like leaving it and going home (ANA, 2019).

The impacting testimony of the young woman reveals that the school represents more than a space in which the contents are learned. It is a place of welcome, of dialogue, of love. Discussions about the role of the school and the teachers today are not recent. There is a consensus that the school and the teacher's doing should abandon the predominant conception of the nineteenth century of mere transmission of knowledge (GADOTTI, 2003). In this perspective, the teacher needs to take on a dialogical, relational, cultural and communitarian posture to break up with the teaching methods based only on objective contents. It is up to him to be ethical, to be a dreamer. It is not possible to educate without a dream, without the Ethics of Care, of loveliness (GADOTTI, 2003). In this regard, Jonas makes a request to the school:

Dear school, I wish you listened more to the students and the opinion of each one to be heard and respected. That there should be more interaction with other classes in the school, do different activities, allow students more freedom to show what they can do and value more students who go to school willing to study and learn. I would also like everyone to sit down and talk about difficulties at school and at home, because we know that some young people go through horrible things in their own home (JONAS, 2019).

The desire for listening, for dialogue and for an attentive look prevails in the young person's letter. Boff (1999) states that the opposite of carelessness and neglect is care. It is more than an act; it is an attitude and therefore represents more than a moment of attention, zeal and unveiling. Care represents an attitude of occupation, concern, accountability and affective involvement with the other. In order to take care of someone, first you have to care about them. Faced with this, we therefore ask: how much do we care about our young people? Are we taking care of our youth?

Gadotti (2003) warns that education is no longer property of the school, but of an entire community. It

is inevitable not to relate this assertion to the beauty of the African proverb that says that it takes an entire village to educate a child (MATHIAS, 2006). However, this statement generates a point of tension, of concern. When we look at our community, the way social relationships ravel and how young people are seen, is it possible to believe that this community educates in a dialogical, human, holistic perspective? Hence, we believe that the school is an institution that has the potential to educate from a perspective that values life, ethics and dialogue.

Nevertheless, what still predominates in the education system is a prescriptive culture based on a basic philosophy, whose formation is understood as a stage for professional insertion. Thus, it is expected that it will train active young people for an active life even though the *modus operandi* young people are looked at makes them look as if they were inactive, idle (PAIS, 2016). It is worth sharing here an activity performed in the workshop that focused on the "Theater of the Oppressed". In this activity the class was divided into two groups: one should elaborate a scene of oppression without speech and gestures, as if it were a completely still painting. The other group should find out what the scene was about and modify it by making it positive. The young people represented a classroom. The teacher turned her back to the students, writing on the board as they raised their fingers signaling that they wanted to be heard. The scene was soon identified by the other group, which tried to form a circle with students and teacher sharing ideas.

This activity was very revealing since it allowed the young people to represent a situation of oppression in the school space without using words. Reflecting on the content of the letters and the representation constructed in the theatrics, it is evident the need for a dialogical education. Paulo Freire (2014), in his book *Pedagogy of the Oppressed*, approaches dialogue in a very detailed way. He uses the concept of dialogical education and deepens this understanding in chapter three of the book "Dialogicity: Essence of Education as a Practice of Freedom". For the author, love is the foundation of dialogue. Those who love to do not wish to dominate. Love is commitment to men and since this commitment is amorous, it is also dialogical (FREIRE, 2014).

In this perspective, he argues that in education dialogue begins in the search for programmatic content. For the banker-educator, in his anti-dialogical position, the content of the dialogue is inexistent: he sees only the program in which he will lecture students. On the other hand, for the educationalist, dialogical, problematizing educator, the program content of education is an organized, systematized and added of elements that the students feedback him in an unstructured way. In addition, Kevin revealed that banker-education was part of his reality "[...] teachers don't care about students. They arrive, explains their topics and that's it." Complementing, Jonas reported the calamities of night schooling in the EJA mode: "At night I started to find it boring. The things (class topics) were very easy. I had nothing to do. The teacher came, explained the subjects and left. Then I began to find it boring and dropped out" and denounced that "[...] Here, the school does not even try to go after you: it does not matter why you left. They do not give a damn about it.

Thus, banker-education, neither dialogical nor loving, contributes to school dropout. Regarding the evasion, the young people indicated that the change to the night school was decisive. Since they had repeatedly flunk, the school allocated young and adult education classes on the night shift. Jonas and Kevin claimed they isolated themselves so they would not get involved in drugs. Alice revealed her involvement with drugs and alcohol and that she would "ditch" classes to go out with friends. The young woman was

under psychological follow-up by the Psychosocial Care Center (CAPS) and the scars on her arms denounced suicide attempts and self-mutilation. David, more introspective, said he found night teaching boring and so he dropped out of school.

In addition to the evasions, flunking also marked the reality of these young people. Ana speaks of her disapprovals as lack of interest and dedication, but it is known that her mother suffers from alcoholism and domestic violence and so the young woman ended up taking care of her younger siblings. Wesley also claimed little dedication; however, his mother's depression and his father's drug use were determining factors for the disapprovals. Vitória and Raquel, who are under sheltering, have their disapprovals directly linked with the violation of their rights.

In view of what has been exposed so far, it is perceived that the passage through the school has been marked by particular meanings that constitute them as individuals. Although these meanings are incorporated in a singular way, they are also very common structural challenges to these young people since they directly imply in their futures and in the jobs to be occupied by them in the future.

3.3 Work

Work, as well as education, is part of the conditions to achieve a better future in the perception of young people. Between them only Jonas and Alice had already turned 18 and could enter the labor market. The rest could work as a Young Apprentice. However, none of them had any jobs at the time of participation in the workshop.

One objective among the goals set by young people for the year 2019 was to get a job. However, the strategies and conditions to achieve them were weakened. First, the lack of documents was verified. In the case of Ana and Wesley, for example, there was a lack of General Registration (ID), Social Security Number (SSN) and Worker's Book of Records (WBR). As for the others, SSN or WBR were missing. So, we ask: how do you get a job without papers? Notwithstanding, the level of education and dropout registries restricted the field of possibilities, since most of the positions for the Young Apprentice Program aims for high school students, so school enrollment is a requirement to participate in the Program. In this regard, we had important conversations with young people and their families reinforcing the importance of documentation, insertion and school attendance to put themselves in the labor market.

Thus, in the discussion about the labor market it became clear that for these young people that a job was a synonym of profession. In order to clarify it, according to Marx's perspective, work can be interpreted as a mechanism producing individuals and societies (VACCARO, 2015). For him, work is a human action that aims to maintain life, and this awareness is what differentiates the human being from the animal. On the other hand, a profession is "specification, specialization and combination of the services of a person who, in order to do so, constitute the basis of a continuous possibility of supply or acquisition" (WEBER, 1999, p. 91).

In the face of this, when talking about their objectives in relation to the labor market, they brought to the debate the profession they wanted. Meanwhile, we asked them how they would achieve such profession, which labor market and whether it required higher education level or not.

During this period, Feevale University was promoting the "Feevale World", which is an event that provides high school students an opportunity to learn about higher education courses. The young people

expressed interest in participating, although they gazed at the university as something far, far away. David and Wesley, who dreamed of being football players, chose Physical Education; Jonas opted for Digital Games; Kevin, Psychology; Ana decided for Nursing and Alice, Raquel and Vitória chose Photography.

Once they had revealed their desire to attend a college, we started to discuss which strategies had been used to achieve this goal. Once again, the question of the present and future arose and, upon reflection over the present scenario, the young people confessed that they were not trying hard enough to achieve their future aspirations and so education returned as an imperative force to achieve them. Therefore, "we can say that if the future is at stake it is because the present was bet" (PAIS, 2016, p. 310). And in this game the path is neither linear nor has a logical sequence of events. We've realize that in these young people's game of life the movements are cyclical, where in order to move forward sometimes it is necessary to return.

In view of this, it is necessary to clarify two things. Firstly, the hybridization between future, present, education and work can be called, according to Pais (2016), as "yo-yo" trajectories. According to the author, the juvenile trajectories are not linear: they look more like a yo-yo that is going round all the time. Many youngsters drop out of school to invest in their professional careers. Later, they realize that without education, their professional career will never take off, then they return to school. In the same yo-yo movement, they pass through the labor market. Unemployment, temporary work and the precariousness of jobs imposes turns, back and forth movements. Secondly, it is common among the grassroots to blame young people for their failures. They fail school because they do not try hard enough, as Kevin, Jonas and Ana stated. They do not get a job because they are not qualified enough, which was proved during the workshop when internship application was denied to those who were out of school. They remain in poverty because they have not committed themselves and therefore do not deserve to leave it, thus reproducing a discourse of accountability without understanding that opportunities for social ascension are not the same for all people.

It is perceived that these young people carry on their shoulders a responsibility that masks the irresponsibility of the State. The latter, in turn, neglects the care of the citizen leaving him at the mercy of the rules of the neoliberal system. In this sense, it can be affirmed that the individual inserted in the current educational system is detached from the protection of the State and follows the logic of neoliberalism (SILVA; SILVA, 2012). And in this mean project called neoliberalism, young people from the lower classes, who are already weakened by their social reality, will continue to be easy prey if the guarantee of their rights is not strengthened. They will remain at the margins of the labor market underemployment and continue feel responsible for the failures in their trajectories.

4. The implications of the social context on the prospects of future

In the face of everything that has been discussed so far, and the emergencies resulting from the experiences proposed in the workshops, it is perceived that young people not only dream of a better future, have ambitions, wish to move up in their lives but also have difficulty in planning ways to achieve their goals. Moreover, school and work appeared as fundamental institutional links in their trajectories. Paradoxically, margins are maintained in both fields. In this regard, in an effort to analyze the contradictions between discourse and practice present in the young people's statements, we resorted to the contributions

of Bernard Lahire. It was possible to realize that for them the change of position in the "game" is not null and that education is the main mean for this change to happen. However, it must be assumed that the disposition to believe is not always related to a willingness to act.

According to Lahire (2004), we live in a society in which actors can incorporate beliefs without having the means to respect, reach and realize them. In addition, they may have incorporated norms and values without creating the habits to act that would allow them to achieve their ideal. Thus, these provisions to believe in education may be associated with the values incorporated in school experiences, since it tends to reinforce the importance of education for life changes, decent work and dream achievements. It is the dream of a better life and in this dream they express "the desire to be something more": more equal, more human, with a more dignified life" (LEÃO, DAYRELL, REIS, 2011a, p. 1081).

The reflections made so far reveal that the lives of these young people are full of somewhat standardized trials in present society cores- family, school, work, territory. However, in this process of coping, their trajectories tend to be increasingly unique (MARTUCELLI, 2010).

The sociologist Martuccelli (2010) defines that these trials are historical challenges which were socially produced, culturally represented and unequally distributed, in which individuals are forced to face a structural process of individualization. According to the author, the school, family and work are trials of institutional nature.

The school plays a role as a structural trial in the lives of young people. They consider it fundamental for their social mobility; however, the institutional conjuncture immediately poses as a challenge for the popular classes. Bourdieu (2007), in his writing "Conservative School And Inequalities Of School And Culture" denounces that school has been one of the most effective factors for the conservation of social inequalities and for the naturalization of gift and merit by requiring one of them in its curricula as cultural⁵, economic and social minimum requirements in order to belong to the elite.

Having said that, the institution stands as a trial, since it is configured as a kind of place where students feel neither in the curricula, nor in the architecture or in the agendas; in other words, they are in a non-place, a space of passage, of transition, unable to form any type of identity (AUGÉ, 2005). From this perspective, the studies Pais (2016); Dayrel and Jesus (2016) Arantes, Pinheiro and Gomes (2019) point out that the school is a type of rite of passage, a constant "wannabe", a waiting room. Therefore, it is necessary for family members and young people to believe in this future investment, in this postdated check (PAIS, 2016), since it is the belief of reward for this effort that will enable the internalization of a necessary discipline to "support" school attendance (DAYRELL; JESUS, 2016). That said, considering that the family can be a support, it can also be a trial which young people have to face.

It was observed that in their letters the family appears as a trial as well when Ana, for example, revealed that sometimes she does not feel like returning home, or when Jonas stated that young people go through horrible things in their own homes. Therefore, the systematization of this experience indicated that for Ana, despite being a great challenge, the school ends up as a support to face the difficulties of her family nucleus. On the other hand, for Jonas the school and the family pose simultaneously as being so difficult that without support to face them he just could not take anything anymore and dropped out.

Hence, it is understood that this set of structural trials directly implies in the construction of future plans and dreams. Perhaps that is the reason why young people just do not have the habit of planning them.

Bourdieu (2007) states that the combination of expectation with the likelihood of their realization operates in a kind of realism that makes one tend to live according to their condition. Therefore, not planning the future can be an expression of a context that offers little possibility of immediate perspective.

Therefore, it is perceived that the juvenile itineraries do not follow a linear time, they are in fact a labyrinth (PAIS, 2016), full of challenges, trials and unforeseen events that constantly tests their resilience and, to some extent, the faith of these young people who just dream for better days. For sure the workshop "Young People in Action" and its methodology represented to them a support to face the obstacles, since it gave them not only a chance to be but also to express themselves. Upon seeking to understand their strategies for living, they also discovered other possibilities beyond those already set up by their context and aiming for a perspective of rights assurance. As an example, it was demonstrated that Ana, at the end of the workshop, was able to enter the labor market as an apprentice, an opportunity that arose through the workshop and that was possible to achieve because she was engaged in school and had enough attendance. Thus, we witnessed an important move that may have been decisive in order to allow her start writing her own future.

Speaking of future, we can say that Rachel began to write a new chapter of hers since she returned to her family. Just as a yo-yo comes out of our hands, the young woman was cast out of her home, walked the path of life but knew that, in a certain moment, she would return to her anchor point that materializes as her family. Thus, we realized that "no one walks without learning to walk, without learning to thread the path by walking, remaking and retouching the dream which one first had set out to walk" (FREIRE, 1997, p.155).

Thus, we conclude that in the face of the various trials that mark the lives of young people and may seize upon their dreams, their future begins today, because in the uncertainties of the path, the plot of life may not always have a successful conclusion.

5. Conclusion

In face of what has been built so far, we were able to conclude that the methodology of systematization of experiences allowed us to identify which elements of youth experiences are determinant for the construction of future perspectives. The methodological approach favored dialogue and allowed revisiting and reliving the moments shared in the workshops.

Upon retaking the process, in a posture of distancing from what we live, we identified that education and work appear in juvenile narratives as an imperative to achieve a better life in the future.

However, their disposition to believe in education and work as decisive elements for a better future were not aligned with their acts. Although they believe in the power of education and work, they remained at the verge of both.

Nevertheless, they do not stay there because they want to do so. We verified that their nonlinear trajectories are marked by very singular structural trials. In this context, the school and the family pose as the main trials that limit the birth of expectations for the future. We were able to verify that the school, its rhythm and spaces do not conceive an education focused on citizenship, participation or dialogicity. As a result, young people remain inactive, only as vessels, while the contents of their lives are ignored. No

wonder some of them dropped out of school. Furthermore, the vulnerabilities of their family contexts also stand as a hindrance: domestic violence; alcohol and/or drugs abuse and depression, along with to the difficulties for subsistence, are challenges that surely hinder their aspirations of a better future.

In conclusion, the systematization of experiences helps pinpoint the challenges young people must endure nowadays. It allows us theorizing the practice and producing knowledge from it thus unveiling the beauty of working with young ones.

6. References

- [1] ANDRADE, S. S. O QUE FAZER NO ANO QUE VEM? ARTICULAÇÕES ENTRE JUVENTUDE, TEMPO E ESCOLA. **Educação em Revista**, Belo Horizonte, v. 33, p. 2-26, 22 jun. 2017. FapUNIFESP (SciELO). Available in: <https://www.scielo.br/scielo.php?pid=S0102-46982017000100119&script=sci_abstract&tlng=pt>. Accessed in: March 11th, 2020.
- [2] ARANTES, V. A; PINHEIRO, V. P. G; GOMES, M. A. G. O valor da escola para os jovens. **International Studies on Law and Education**, São Paulo, Mandruvá, n. 31/32, p. 165-176, 2019. Available in: <https://www.researchgate.net/profile/Viviane_Pinheiro2/publication/331249433_O_valor_da_escola_para_os_jovens/links/5c6e86e0a6fdcc404ec21b19/O-valor-da-escola-para-os-jovens.pdf>. Accessed in: March 20th, 2020.
- [3] AUGÉ, M. **Não-lugares**. Papirus Editora, 2007.
- [4] BOFF, L. **Saber Cuidar Ética do humano - compaixão pela terra**. Petrópolis: Vozes, 1999. 199 p. Available in: <<https://renasf.fiocruz.br/sites/renasf.fiocruz.br/files/artigos/BOFF%2C%20Leonardo.%20Saber%20cuidar.%20%2C%20A9tica%20do%20humano%2C%20compaix%C3%A3o%20pela%20terra.pdf>>. Accessed in: June 11th, 2020.
- [5] BOURDIEU, P. **A escola conservadora**. Escritos de Educação. Petrópolis, RJ: Vozes, p. 41-64, 2007.
- [6] BRASIL. Ministry of Social Development and Strategies against Hunger (MDS), National Office for Social Assistance (SNAS), Department of Basic Social Protection (DPSB); **Perguntas frequentes Serviço de Convivência e Fortalecimento de Vínculos**(SCFV) Brasília, 2017.
- [7] CASTEL, R. A DINÂMICA DOS PROCESSOS DE MARGINALIZAÇÃO: da vulnerabilidade a "desfiliação". **Caderno Crh**, Salvador, v. 27/28, p. 19-40, dez. 1997. Available in: <<https://portalseer.ufba.br/index.php/crh/article/view/18664/12038>>. Accessed in: November 11th 2019.
- [8] DAYRELL, J. T; JESUS, R. E. de. JUVENTUDE, ENSINO MÉDIO E OS PROCESSOS DE EXCLUSÃO ESCOLAR. **Educação & Sociedade**, Campinas, v. 37, n. 135, p. 407-423, jun. 2016. FapUNIFESP (SciELO). Available in: <<https://www.scielo.br/pdf/es/v37n135/1678-4626-es-37-135-00407.pdf>> . Accessed in: November 25th 2019.
- [9] DAYRELL, J. A escola. **Educação & Sociedade**, Campinas, v. 28, n. 100, p. 1105-1128, out. 2007. FapUNIFESP (SciELO). Available in: <<https://www.scielo.br/pdf/es/v28n100/a2228100.pdf>>. Accessed in: November 25th. 2019.
- [10] FALKEMBACH, E. M. F. Sistematização em educação popular: uma história, um debate. **Reunião**

- Anual da ANPED, v. 30, p. 18, 2007. Available in: <https://portalseer.ufba.br/index.php/crh/article/view/18664/12038>. Accessed in: Abril 10th. 2020.
- [11] FOUCAULT, M. **Vigiar e Punir** : história da violência nas prisões. 27. ed. Petropolis: Vozes, 1987. 288 p. Translated by Raquel Ramallete.
- [12] FUNDAÇÃO GETÚLIO VARGAS. **Juventude e Trabalho: Qual foi o Impacto da Crise na Renda dos Jovens? E nos Nem-Nem?** . Available in: <<https://cps.fgv.br/juventude-trabalho>>. Accessed in: March 12th. 2020.
- [13] FREIRE, P. Pedagogia do oprimido. 56. ed. Rio de Janeiro: Paz & Terra, 2014
- [14] FREIRE, P. Pedagogia da esperança: um reencontro com a pedagogia do oprimido. 4. ed. São Paulo, SP: Paz e Terra, 1997. 245 p.
- [15] GADOTTI, M. A boniteza de um sonho: ensinar-e-aprender com sentido. Novo Hamburgo: Feevale, 2003. 80 p.
- [16] HOLLIDAY, O. J. **Para Sistematizar Experiências**. 2. ed. Brasília: MMA, 2006. 128 p. Tradução Maria Viviana V. Resende. Available in: https://www.mma.gov.br/estruturas/168/publicacao/168_publicacao30012009115508.pdf>. Accessed in: March 11th. 2020.
- [17] HOLLIDAY, O. J. Sistematização de Experiências: aprender a dialogar com os processos. **CIDAC: Rio de Janeiro**, 2007, p. 9-71.
- [18] LAHIRE, B. **Retratos sociológicos: disposição e variações individuais**. Porto Alegre: Artmed, 2004. Tradução Didier Martin e Patrícia Chittoni Ramos Reuillard.
- [19] LEÃO, G; DAYRELL, J. T; REIS, J. B. dos. Juventude, projetos de vida e ensino médio. **Educação & Sociedade**, v. 32, n. 117, p. 1067-1084, 2011a. Available in: <https://www.scielo.br/scielo.php?pid=S0101-73302011000400010&script=sci_arttext&lng=pt>. Accessed in: November 25th. 2019.
- [20] LEÃO, G; DAYRELL, J. T; REIS, J. B. dos. Jovens olhares sobre a escola do ensino médio. **Cadernos Cedes**, v. 31, n. 84, p. 253-273, 2011b. Available in: <https://www.scielo.br/scielo.php?pid=S0101-32622011000200006&script=sci_abstract&lng=pt>. Accessed in: November 25th. 2019.
- [21] LIMA M. C. W. **“Disposições para crer, disposições para agir”: jovens de escola pública pensando a educação, o trabalho e o futuro**. 2013. Dissertação (Master Degree in Public Political Sciences) –Psychology College, Ceará State University, Ceará. Available in: <<http://groundsmart-mail.com/documents/disposicoes-para-crer-disposicoes-para-agir-insercao-no-ensino.html>>. Accessed in: June 6th. 2020
- [22] MARTUCCELLI, D. A individuação como macrosociologia da sociedade singularista. **Pessoa e sociedade** v. 24, n. 3, p. 9-29, 2010. Available in: <<https://personaysociedad.uahurtado.cl/index.php/ps/article/view/196/191>>. Accessed in: May 18th 2020.
- [23] MATHIAS, Antonio Jacinto. É preciso uma aldeia inteira para educar uma criança. **Cadernos Cenpec | Nova série**, [S.l.], v. 1, n. 2, ago. 2006. ISSN 2237-9983. Available in: <<http://cadernos.cenpec.org.br/cadernos/index.php/cadernos/article/view/167/196>>. Accessed in: July 8th, 2020.

- [24] NUNCA me sonharam. Direção: Cacau Rhoden. Brasil: Maria Farinha Filmes, 2017. Available in: <https://www.videocamp.com/pt/movies/nuncamesonharam>. Accessed in June 8th, 2020.
- [25] PAIS, J. M. **Ganchos, tachos e biscates: jovens, trabalho e futuro**. 4. ed. Berlin: Edições Machado, 2016. Available in: https://www.researchgate.net/publication/331346485_Ganchos_tachos_e_biscates_4_edicao. Accessed in: June 10th, 2020.
- [26] SILVA, A. C. B. da; SILVA, M. C. C. B. da. A escola na condição de não lugar. **Pesquiseduca**, v. 4, n. 8, p. 340-362, 2012. Available in: <https://repositorio.unesp.br/handle/11449/127042>. Accessed in: March 20th, 2020
- [27] SILVA, I. M. M; LEME, M. I. S. PROJETOS DE VIDA E EDUCAÇÃO: narrativas de jovens das camadas populares sobre suas experiências. **Revista Inter Ação**, Goiânia, v. 44, n. 1, p. 77-92, 9 maio 2019. Federal University of Goiás. Available in: <https://www.revistas.ufg.br/interacao/article/view/55686/33073>. Accessed in: March 20th, 2020.
- [28] VACCARO, S. B. Karl Marx e Hannah Arendt: uma confrontação sobre a noção de trabalho. **Sociologias**, Porto Alegre, v. 17, n. 40, p. 358-378, dez. 2015. FapUNIFESP (SciELO). Available in: <https://www.scielo.br/pdf/soc/v17n40/1517-4522-soc-17-40-00358.pdf>. Accessed in: April 20th, 2020.
- [29] VELHO, G. **Projeto e Metamorfose Antropologia das Sociedades Complexas**. Rio de Janeiro: Jorge Zahar, 1994.
- [30] WEBER, M. **Economia e sociedade: fundamentos da sociologia compreensiva**. Vol. 1. Brasília: EdUnB, 1999.
- [31] ZUCCHETTI, D. T; MOURA, E. P. G. de; LACERDA, M. P. de. EDUCAÇÃO NÃO ESCOLAR. ESTRATÉGIAS PEDAGÓGICAS ALTERNATIVAS. **Revista Prâksis**, Novo Hamburgo, v. 1, p. 272-288, fev. 2019. ISSN 2448-1939. Available in: <https://periodicos.feevale.br/seer/index.php/revistapraksis/article/view/1716> > Accessed in: May 22nd, 2020.

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/>).