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About the Journal

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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-6, ISSUE-2 of IJIER* which is scheduled to be published on **28th February 2018**.

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 screensed 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

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Students perceptions of using a second language in a mother tongue dominated environment: Contrastive Analysis

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Abstract

While English is an official language which holds a significant role in education not only as a medium of instruction but also a subject of study from primary to tertiary level in Rwandan education system, some students still stick to their mother tongue in an academic environment which impedes second language education and quality education as a whole. Based on Communicative approach and Contrastive Analysis, the present study explores students' perceptions of using a second language in a mother tongue dominated environment. The study involved 36 Diploma students from language education combinations. The questionnaire was used for data collection. Analysis revealed that students' mother tongue environment affects their second language use. It was recommended that efforts be made to practise and improve their English language for effective communication.

Keywords: Foreign language, English, communicative approach, mother tongue, academic environment

Introduction

"The difference between who you are and who you want to be is what you do," (said Bill Phillip). I choose these words to introduce this study as they embed the idea of 'practice makes perfect'. A language is a tool for communication and second language knowledge opens the gates for the learner(s) to interact with wider speech communities. Gass & Selinker (2008) advocate that most second language learners do not achieve the same degree of knowledge and proficiency in a second language as they do in their native language and said that some learners appear to achieve native-like proficiency in more than one language. This is mostly due to each of the learners' exposure to and / or efforts in that language. Second language use is affected by a number of factors including but not limited to students' perceived ability in that language; frequency of use with speakers of that language; its use to read for enjoyment; its use for communication at home; integrative motivation; and career aspirations (Latu, 1994) and among these factors environment exposure plays a significant role as language acquirers are not usually aware of the fact that they are acquiring language, but are only aware of the fact that they are using the language for communication(Krashen, 2009). This study is concerned with such issue putting particular emphasis on the impact of a mother tongue dominated environment on foreign language use with particular interest in English, an official language

and medium of instruction in Rwandan schools where it has a profound role in the achievement of the country's vision 2020 to have become a knowledge-based and technology led economy (REB, 2015).

Background and problem statement

Every research project starts with an idea; something that the researcher is interested in knowing more about or is worried about; something that is perceived as a problem or as a knowledge gap that needs to be filled (Hewitt, 2007). The situation of English language use in Kinyarwanda speaking environment is concerned here. Language learning aims primarily to enable learners to communicate and interact with people and the speech community of that language. Ordinarily, language is inextricably tied up with culture, and most people's concern about language is only part of their concern about the whole culture (Taumoefolau qtd in Latu, 1994:1). In fact, two different languages imply two different cultures and, as such, too much exposure to mother tongue environment in second language learning process can impede mastery or fluency of that language. Given that Kinyarwanda and English are two distant languages from each other - one is a Bantu parcel while another belongs to the family of Germanic languages; there is a likelihood that such distance can be a challenge for native speakers of Kinyarwanda to learn and practise effectively English. While the latter is used as an official language that holds a significant role in education not only as a medium of instruction but also a subject of study from primary to tertiary level in Rwandan education system, learners still have a bad culture of resorting to their mother tongue in academic activities. Such a situation still needs be addressed in the best possible way to mitigate related consequences that may impede quality education. As academic staff in the Department of Humanities and Languages Education, I was triggered by students' interaction mainly their conversations often dominated by their mother tongue [Kinyarwanda] while they are always encouraged to practise English language especially in Academic setting, i.e., at the college. When I was usually sitting in my office carrying out academic administration, most of the students who came for some services wanted to state their problems using Kinyarwanda which is their mother tongue. As one of the teachers responsible for language education, I usually tried to grapple with the situation as I could, but the problem still stagnates. I thought that these students go against Falk's belief that students who are most successful when learning a target language [English in this situation] are those who admire the culture of its speech community and have a desire to become familiar with or even integrate into the society in which the language is used. Now that I invited and encouraged them to express themselves in English so that they could be familiar with it, some tried hard, but many got stuck. This made me remember a similar class situation when I assigned learners a group activity during Literature lesson in year one, Diploma Program. In their groups, they had tendencies to discuss using their mother tongue but were forced and grabbled to use English as it was Literature in English. Hence, I realized that some students have difficulties of using English in their academic activities which can impact their language proficiency. As such I decided to conduct a research based on theories of second language learning; paying particular attention to environment they are exposed to and how the latter plays a part in their gaps of using the target language.

Study objectives

The leading objective of this study was to explore students' perceptions of using a foreign language in a mother tongue dominated environment. Further, the study sought to investigate students' ability to use English in a mother tongue dominated environment; to identify the factors impeding students' use of a foreign language in a mother tongue setting, and to propose measures for the problem to be addressed for students' effective communication. In this study, I considered second language acquisition as generally referring to the learning of a nonnative language in the environment in which that language is spoken (Gass & Selinker, 2008).

Study questions

This study is concerned with using English as a foreign language in Kinyarwanda dominated environment. The research was guided by the main question underpinned by three primary questions in line with the study objectives: The primary question is: What are the students' perceptions of using a foreign language in a mother tongue dominated environment? The Secondary questions are the following: How far are students able to use English in Kinyarwanda dominated environment? What are the factors affecting students' use of English language in an academic environment? How can the problem be addressed for students' effective communication?

Study scope and significance

Research originates from dissatisfaction with what we know and have today and the need for more to improve the current conditions as regards the gap between theory and practice (Sibomana qtd in Bazimaziki, 2017). This study was conducted on level two students of diploma program during the academic year 2017-2018. All students were not involved. Rather, I intentionally chose Department of Humanities and Language Education specifically language education combinations. The reason is grounded in that they are being trained to teach English and are consequently much more concerned with language issue than other students within the same department. The study significance is two-fold. First, it reveals the situation as regard language learning and teaching so that, having known their gaps, students and teachers can take action to improve where necessary. Second, teachers of English language will have a good picture of their students' challenges in using that language. Further, researchers in the same ground will investigate into language education having some background knowledge about using the second language in a mother tongue exposed environment. Thus, this study is empirically, theoretically and practically significant.

Theoretical Framework

Linguistic competence without communicative competence cannot suffice for a language learner to interact with other language users. This is why there had been a shift from the linguistic structure centered approach

to communicative approach in the late 1970s and 80s (Ankitaben, 2015). A language is a tool of communication and in fact, ought to be learned using communicative approach. In this regard, bearing in mind the nature and aim of this study, I deemed necessary to frame it on Richards (2006) principles of communicative approach besides Contrastive Analysis Hypothesis (CAH) which posits that if similarities between two languages exist, the language learner will acquire the second language more easily, but if differences are encountered the acquisition of the target language will be more difficult (Fries & Lado qtd in Byung-gon, 1992), i.e., "in the comparison between native and foreign language lies the key to ease or difficulty in foreign language learning...Those elements that are similar to [the learner's] native language will be simple for him, and those that are different will be difficult". While grammatical competence is an important dimension of language learning, it is clearly not all that is involved in learning a language since one can master the rules of sentence formation in a language and still not be very successful at being able to use the language for meaningful communication. The latter is understood in terms of communicative competence and includes the following aspects of language knowledge: knowing how to use language for a range of different purposes and functions, knowing how to vary our use of language according to the setting and the participants (e.g., knowing when to use formal and informal speech or when to use language appropriately for written as opposed to spoken communication), knowing how to produce and understand different types of texts (e.g., narratives, reports, interviews, conversations), knowing how to maintain communication despite having limitations in one's language knowledge (e.g., through using different kinds of communication strategies).

Communicative language learning, according to Richards (2006), was formerly viewed as a process of mechanical habit formation. Good habits are formed by having students produce correct sentences and not through making mistakes. Errors were to be avoided through controlled opportunities for production (either written or spoken). By memorizing dialogs and performing drills, the chances of making mistakes were minimized. Learning was very much seen as under the control of the teacher. However, in recent years, language learning has been viewed from a very different perspective. It is seen as resulting from processes such as interaction between the learner and users of the language, collaborative creation of meaning, creating meaningful and purposeful interaction through language, negotiation of meaning as the learner and his or her interlocutor arrive at understanding, learning through attending to the feedback learners get when they use the language, paying attention to the language one hears (the input) and trying to incorporate new forms into one's developing communicative competence, trying out and experimenting with different ways of saying things. Thus, the theory of Communicative approach as described above fits for a study of this type.

Literature Review

Second language learning and the influence of mother tongue in second language use, in particular, have been so far the topics of interest in the ground of various linguistic studies. Mother tongue or mother language denotes the language learned in the home from older family members (UNESCO, 2003) while second language refers to the target language or the language of the classroom or the foreign language (Richards & Rodgers, 2002) or a non-primary language; a language beyond the native language, any

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language learned after learning the L1, regardless of whether it is the second, third, fourth, or fifth language (Gass & Selinker, 2008). Opitz (2011:1) explains that whoever has learned a second language (L2) at some stage in their life will, without using that language for some period of time, have experienced certain changes and increased difficulties to communicate in it in conversation in particular as some previously mastered structures will be forgotten hence loss of fluency and of the ability to use language idiomatically. In other words, their language skills become "rusty." The situation stands that language learned for communication purpose gets lost easily in case it is not used. The issue is that second language learners more exposed to a mother tongue environment are likely to face challenges and do not have the same chance of mastering that language as those exposed to a different environment where their second language is practised. Lan (2005) advocated that more exposure to a foreign language offers a mere chance and an authentic environment to be able to use it for real and meaningful communication with its speakers. The author agrees that exposure to English enabled her to develop her basic interpersonal skills (BICS), as developed in Cummins (1980) i.e., social language for interaction, such as ordinary greetings and leavetakings; and Cognitive Academic Language Proficiency (CALP), i.e., the vocabulary, forms, and pragmatics necessary for succeeding in an academic setting. The point she made is without any doubt a witness that learning a language can be much easier when the learner lives with people who use that language in their daily activities, particularly in an academic setting. Klein (1986:25) explored similar point as echoed by the proponents of contrastive analysis hypothesis who claim that if similarities between two languages exist, the language learner will acquire the second language more easily, but if differences are encountered the acquisition of the target language will be more difficult. Paul Nation as qtd in Jancova (2010) claims that learners often avoid using the target language because they do not want to feel embarrassed about the mistakes they make. Inherently, in second language learning mistakes must not be avoided as they are part of learning. The problem with many second language learners is that they feel embarrassed and the more they fear, the more they will stay behind practice. Thus, it must be noted that young children learn [and use] a second language in different ways depending upon various factors, including their culture, particularly the status of their culture, language, and community within their larger social setting(Ball, 2013). Be that as it may, while English is currently a dominant global language, academics and scholars from non-English backgrounds are at a disadvantage since they have to adhere to a medium that is different from their mother tongue (Sibomana, 2016) the latter having a big influence on second language use especially when the two languages are far distant from each other.

Methodology

This research is a descriptive survey study that mainly used mixed methods integrating qualitative and quantitative methods. Wisdom & Creswell, (2013) opine that mixed methods approach refers to an emergent methodology of research that advances the systematic integration of quantitative and qualitative data within a single investigation or sustained program of inquiry. This study agreed with this method as it involved both qualitative and numerical data generated from the questionnaire. The study was conducted using a sample of 36 students selected purposively from College of Education by their combinations namely Swahili English Education, Kinyarwanda English Education and French English Education.

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Convenience sampling technique was used to determine the sample size for this study. As research put it, a sample of convenience sampling consists in selecting from the target population by their accessibility or convenience to the researcher. Convenience samples are sometimes referred to as 'accidental samples' for the reason that elements may be drawn into the sample simply because they just happen to be situated, spatially or administratively, near to where the researcher is conducting the data collection (UNESCO, 2005). Data were collected using questionnaire which consisted of 10 closed questions regarding students' perceptions of using English in Kinyarwanda dominated environment. These questions covered the themes such as the use of English in academic environment, challenges in practicing English and how they can be mitigated, i.e. the role of the learners, teachers and the college in general. The questionnaire intended to reveal if learners' mother tongue has a considerable impact on their language proficiency. A four-point Likert scale ranging from 1 to 4, (1. Strongly agree; 2. Agree; 3. Strongly disagree; and 4. Disagree) was used to indicate the perceptions of respondents on those questions. Besides, three open questions were used to know the respondents' views as regard measures to improve students' use of English. As the major ethical issues that govern the research include making consent with respondents, respect for anonymity, confidentiality and respect for privacy and security (Bryman, 2008), this study took it into consideration. Before collecting data, the researcher explained the respondents the purpose of the research so that they could have a complete understanding about what was expected from them. Participants' choice to participate in the study was free. Data from participants were treated with confidentiality and were solely used for the research purpose they were intended for by the researcher. Statistical Package for Social Sciences (SPSS) was used for data analysis.

Presentation of results

The results presented below are generated from respondents' views as reordered in Statistical Package for Social Sciences (SPSS).

Category	Frequency	Percent	Valid Percent	Cumulative Percent
20	3	8.3	8.3	8.3
21	10	27.8	27.8	36.1
22	11	30.6	30.6	66.7
23	6	16.7	16.7	83.3
24	6	16.7	16.7	100.0
Total	36	100 .0	100 .0	

Table 1: Tables showing Demographic situation of respondents Respondents' age

As indicated in the above table the age of respondents ranges between 20 and 24. Majority of respondents are 22 years old (30,6%), next comes the category of 22 years (27.8%), then 23 and 24 years(16.7% for each category) and a few respondents(8.3%) are 20 years old.

Respondents' gender					
Category	Frequency	Percent	Valid Percent	Cumulative Percent	
Male	21	58.3	58.3	58.3	
Female	15	41.7	41.7	100.0	
Total	36	100.0	100.0		

The above table reveals that most respondents (63.9%) are from SEE (Swahili English Education), 22.2% are KEE (Kinyarwanda English Education) students while few of them (13.9%) are FEE (French English Education) students. It is important to mention here that all these students were doing Diploma program of University of Rwanda- College of Education.

STATEMENTS				STUDE	NTS' VIE	WS
	SA (%)	A (%)	SA&A (%)	S D (%)	D (%)	SD & D (%)
1. I have difficulties in speaking	0.0	6.6	6.6	33.3	60.1	93.4
English and cannot use it in the						
college						
2. I can hold a conversation in English	2.8	63.9	66.7	11.1	22.2	33.3
3. I use English only for classroom	2.8	22.2	25	41.7	33.3	75
activities						
4. When I want to interact with others	16.7	44.4	61.1	2.8	36.1	38.9
colleagues, I prefer English						
5. When I go to contact lecturers, I use	27.8	41.7	69.4	1.2	29.4	30.6
English but not Kinyarwanda						
6. When I go to other offices, I use	33.3	38.9	72.2	13.9	13.9	27.8
Kinyarwanda						
7. I don't use English outside	36.1	22.2	58.3	16.7	25	42.7
classroom because Kinyarwanda is						
commonly used in the college						
8. I don't use English because my	36.1	36.1	72.2	19.4	8.4	27.8
colleagues prefer Kinyarwanda						
9. I don't use English because I fear to	38.9	27.8	66.7	11.2	22.2	33.3
be embarrassed when I make mistakes						
10. I don't use English for other	31.6	21.2	52.8	30.5	16.7	47.2
offices because they prefer						
Kinyarwanda						

Respondents' views on coping with challenges of speaking English in the college

The results presented below are the respondents' views on the role of students, teachers, and University to grapple with challenges that impede effective use of English in an academic environment. Three questions were given to students such as: (1) what can students do to improve their communication skills in the English language? (2) What should the teacher do to help students improve their language? (3) What can University do to help students improve their communication skills in English? I presented the results in a table as shown below. Most respondents suggested the following solutions grapple with students' difficulties of little use of English in an academic environment:

Students' role	Teachers' role	University's role
Join clubs and other group	Stick to English as a medium of	Establish rules and regulations
discussions.	instructions without translating	of using English within
Avoid fear and feel confident in	into Kinyarwanda what is being	University or College
themselves.	taught.	community.
Read enough and listen to	Not allowing students to give	Provide teachers with enough
English texts including TV,	their answers in Kinyarwanda in	audio-visual teaching and
Radios.	other subjects.	learning materials and build a
Attend conferences and	Create and give enough	language laboratory
meetings held in English, Watch	opportunities for learners to	Encourage employees to stick to
movies in English.	speak during the teaching and	English during service delivery
Use English whenever they	learning exercise and assign	in their offices.
need a service from an office in	them works to be presented	Hold students' meeting in
the college.	orally and be considered as part	English only.
Engage conversations and	of Continuous Assessment Tests	Regular inter- combination
discussions in English among	Use audio-visual teaching and	competitions on debates and
themselves.	learning materials.	public speech delivery.
Tell stories and jokes in	Ensure that each student can	Organize inter-universities
English, Commitment to using	describe something in English.	competitions at national and
English outside the school.		international levels and
		empower language clubs and

Table showing respondents' views on mitigating challenges that impede effective use of English

Discussion

The primary aim of language learning is communication. As the saying goes that practice makes perfect, second language learners must practice the language if they want to be fluent in it. However, lack of practice of English due to Kinyarwanda influence among students impedes fluency in that language. In fact, respondents' view revealed that they could use English, but practice is what matters. Most students (93.4%) posit that they don't have special difficulties to speak English. They are thus able to use it because they have learned it as a second language and have been trained in it all their studies as a medium of instruction in Rwandan Education system from primary to tertiary education. Similarly, a great number of respondents

media clubs.

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posit that they can hold a conversation in English (66.7%). The two situations can lead to the conclusion that students can use that foreign language. Unlikely, few of them revealed that they use English regardless of any mistakes they may make while (66.7%) revealed that they don't use English because they fear to be embarrassed when they make mistakes. Now that they are able but fear, the problem still that they need a lot of opportunities to practice English so that when exposed to debates and other kinds of public discussions, they can grapple with such barriers. It is important that students would like to use English even beyond the classroom as 75% posited that they prefer using English not only in the classroom but also outside. In the similar situation, 27.8% strongly agree that they resort to English when contacting their teachers while 41.7% agree that they do so. The implication is that (69.4%) of respondents use English when they are going to their teachers' offices which is interesting as teacher-student- interaction is concerned. Contrary, outside classroom, Kinyarwanda interferes and impedes them to interact in English as 72.2% contended that when they want to use English, their colleagues prefer Kinyarwanda. In connection with this point, 58.3 % of respondents said that the fact that Kinyarwanda is commonly used in the campus affects greatly their will to use English, unlike 41.7%. Regarding students use of English when they go to other offices in the college, the majority (52.8%) revealed that they don't use English when going for services from offices in the college. While offices in the college should help learners improve that language by encouraging them to ask for service using English, students views show that in most offices English is not mandatory. It follows that students use the language that is used there as there don't encounter any problem in that situation. Thus, it is a big challenge for students to practice English as the environment does not push them to make efforts to use that language.

As to how these challenges can be mitigated, students' perceptions involved the three sides in acting as one in a bid to promote communication in English. Students' views based on answers to three questions about the role that should be played by each of the three sides such as students, teachers, and the university. Among other things, respondents suggested that students should be active and be committed to knowing English by joining the clubs and other group discussions within the college. They add that they should avoid fear and feel confident of themselves, attend conferences and meetings held in English, read enough and listen to English texts including TV, Radios, watch movies in English, tell stories and jokes in English Engage conversations and discussions in English among themselves, use English not only in class but also outside the school, thus use English whenever they need a service from an office in the college and do their best to be exposed to English speaking situation.

On the other hand, the role of the teachers cannot be left out. In fact, teachers are those who guide students and facilitate their learning. As respondents suggested, teachers should stick to English and break down the culture of translating into Kinyarwanda for learners. As Fromkin et al. (2011:464) translating from the target language into the native language implies little use of the target language for communication. It emphasizes the teaching of grammar rules, focusing on accuracy, and writing with little or even no systematic attention paid to speaking or listening "Its principal method is translating from and into the target language, and the learners' native language is maintained as the reference system in the acquisition of the second language." This cannot happen by, and large help learners improve their communication skills. As respondents suggested that teachers ought to create opportunities for students to participate in

oral presentations of their group actively works to enhance their communication skills. Inherently, teachers ought to minimize, if not discourage, students resort to mother tongue during teaching and learning exercise.

University role to grapple with challenges impeding students' use of English cannot be undermined. Facilities can trigger learners to improve and fill the gaps in some knowledge practice. The College ought to provide teachers with enough audio-visual teaching and learning material and language laboratory as well. Further, intra and inter-universities competitions at national and international level can contribute to solving the issue progressively. Encouraging employees to regularly use English during service delivery and holding students' academic meetings in English can motivate students to improve their language too.

Summary and conclusion

Education, second language education, in particular, is better when it benefits the trainees, and the latter's pride lies in their mastery and effective use of the acquired knowledge, competencies and skills for the betterment of their future. This has been the main concern in this study where Kinyarwanda dominated environment still impedes second language mastery. Framed on Communicative Approach and Contrastive analysis Hypothesis to a certain extent, the study used the questionnaire as a research instrument to gather information. Qualitative and quantitative analysis revealed that a number of factors are at the center of students' lack of English practice such as exposure to Kinyarwanda language which is a distant language from English; fear and feeling of being embarrassed if they make mistakes while they can use it if they break down that fear and feel confident. To grapple with the issue, new method of language teaching particularly communicative language teaching approach ought to be given more room so that at the completion of their degree studies graduates cannot feel frustrated due to poor communication skills which often disqualify them from job competition. Teachers should use audio-visual teaching and learning materials to help learners get in touch with English use in different situation. Teachers should stick to English as a medium of instruction. Learners should be given enough opportunities for group work presentations. Learners, particularly students whose combinations are related to languages education, are advised to play their part and break down that bad culture of not using English in school environment and even beyond particularly because Rwanda Education Board (2015) believes that besides being one of the official languages, English is also useful for learners to integrate into business and working situations in Rwanda. University should provide teachers with enough audio-visual teaching and learning aids. A language laboratory should be availed to facilitate students' practice. Should all offices in the college use English in service delivery to students, the latter would feel responsible for using it. Respondents suggested that students' academic meeting be held in English for them to be familiar with that language too. As the present study was carried out on a small group of students in College of Education, University of Rwanda, this is one of the limitations. Due to this drawback, I cannot pretend that the situation is the same in other colleges. So, based on the study findings, it is high time I recommended further researches to be carried out to investigate similar issues using a considerable sample that can find out more about English and other foreign languages taught in the University of Rwanda. Researchers of this kind can use observation and more research tools to bridge the gaps in the present. In the same line, teachers' perceptions of teaching

English language or foreign languages in a mother tongue dominated environment can be investigated as related studies.

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Development and Breakthrough in Chinese Market for Online Video Recruitment Platform in The Era Of "Internet +"

----A Case Study of HireVue in the United States

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Abstract

With the help of "Internet +" technology, online video recruitment has overcome the defects of low coverage rate, high cost and poor effect of traditional recruitment mode. Compared with the traditional offline recruitment and general online recruitment, it is more flexible in operating mode, personnel screening, and decision-making mechanism. Better user experience, and higher quality of recruitment. Taking HireVue in the United States as an example, the online video recruitment platform has the potential of Chinese investment value and market development. However, there are economic and administrative barriers to entry, with high yields and high risks coexisting. In the future, we should consider those small to medium enterprises as the focus. Establishing multiple interaction modes; combining endogenous and exogenous financing; establishing a perfect credit system; And focusing on resource openness and private security.

Keyword's: "Internet+"; online video recruitment platform; online recruitment; HireVue

1. Foreword or introduction and Literature review

With the continuous development of "Internet +" technology, the defects of traditional recruitment mode, low coverage, high cost and poor effect gradually appear.Meanwhile, the new recruitment mode, recruitment efficiency, and recruitment effect are constantly emerging. The change and practice of recruitment, under the environment of "Internet +," has prompted scholars at home and abroad to study it.

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The study of foreign scholars has been carried out from the perspective of interview measurement, effective channels of recruitment and influencing factors.Jones (1998) took the lead in providing a clearer illustration of online recruitment^[1], and Lee (2009) defined it as organizations identify and attract potential employees through a variety of electronic devices and networking technologies.^[2]Cappelli Peter(2001) believes that online recruitment includes four steps below: recruitment advertising and web design; applicants for network assessment technology evaluation; online contact; traditional interview^[3]. Timberlake(2006) found that online recruitment is a very effective and economic recruitment method, especially for large enterprises, through data analysis^[4]. Mc Dougall(2011) found that the real-time interaction degree of the online recruitment process and the subjective cognition of the applicant were positively correlated with the recruitment attraction^[5].

In China, Yu hongyi (2013) and zhang yan (2015) pointed out that there are some problems in website recruitment, such as personal information disclosure, mixed web sites, false information, and low success rate^[6]. He Fei, Liu Benhan et al. (2014) considered that recruitment channels, corporate reputation, and employee engagement are the main factors influencing the effectiveness of online recruitment^[7]. Jin Peng (2017) studied the multi-interactive network recruitment system in the Internet era, and Ren minmin (2016) et al. studied the network recruitment of high-tech talents in Beijing high-tech enterprises.

Zhang Jianguo, the CEO of chinahr.com, pointed out that "the emergence of video recruitment service will make the traditional job fair officially farewell to the historical stage." However, there are few existing studies now. Yuan Sen (2017) pointed out that online video recruitment is an emerging model that accords with the law of economic development. With the further development of the Internet+, more and more organizations and candidates will choose this model ^[8].

As we can see, the "Internet+" Age with the characteristics of information transparency, beyond time and space, the links and share, Focus on "people" itself ^[9], making it collide with human resources management with lots of sparks. Related scholars focus on the micro mostly. The effectiveness of the online recruitment, the influencing factors, and existing problems was studied, however there still some defect, such as a lack of standard measurement of the sexual availability of online recruitment; few of the recruitment process of research and evaluation; less research on this new thing about online video recruitment platform.Relevant research in China has not kept pace with the application of industry development, and theory lags behind practice.

2. Comparison of online video recruitment and existing recruitment methods

2.1 Contrast with offline traditional recruitment methods

The online video recruitment, like all Internet recruitment, has an unparalleled advantage compared with traditional recruitment methods. First of all, the openness and diffusivity of information provide more options for both parties to break through time and space limitation. Second, the network video recruitment fee is low, which can save recruitment publicity and recruitment travel expenses. However, at the same time, online video recruitment also has the common flaw of Internet recruitment. For example, it is difficult

to judge the true degree of information on both sides. Also, The Chinese Internet market is still emerging thing. Related management system and standardize are imperfect. Irregularities in the virtual world are more likely to converge and amplifier, affecting recruitment

2.2 Compared with the general Internet recruitment platform

According to the United States, "Fortune Magazine" statistics, more than 88% of Fortune 500 companies use online recruitment^[10]. As an emerging online video recruitment platform for "Internet + HRM," there is the advantage that traditional online recruitment does not have.

2.2.1 Different operating modes

Online video recruitment platform is similar to Tencent video, iQIYI network video playback client, all applicants can be registered login at any time, to browse different industry job candidates interview videos.

Unlike those general network recruitment, online video recruitment process is to choose one or several enterprises enter the system firstly, and then start video assessment, to do the online video interview. Finally, the interviewer gets a comprehensive conclusion through the analysis of the large data and artificial intelligence.

2.2.2 Different personnel screening and decision-making mechanism

In the general network recruitment, the decision-making body is HR personnel; the Internet only plays the role of a link between recruiter and candidate.HR staff and candidates must be online at the same time; recruitment decision-making subjectivity is strong. However, on the online video recruitment platform, the Internet can be the role of a link for decision-making and provide scientific data analysis at the same time.Candidates can record video anytime, anywhere.Meanwhile, recruiters can also view it anytime, anywhere. The results of the hiring process are determined by big data, artificial intelligence, and recruiters.

3. Market potential and investment value analysis of the online video recruitment

platform

The product life cycle is divided into four stages: introduction period, growth period, maturity stage and decline phase, as well as online video recruitment, the emerging products of "Internet + human resource management." This model is in line with the trend of the rapid development of Chinese technology. As long as the time and environmental conditions are ripe, the Chinese market will likely be crowded with the blowout trend.

3.1 The unique advantages of online video recruitment platform

3.1.1 Great flexibility

Enterprise interview content customized by online video platform, according to the characteristics of

employers, relatively fixed. The structured interview can not only avoid the reliance on resumes of the traditional video interview and subjective factors but also effectively match the most suitable talents, according to the individual needs of employers. Choosing any time and place to record, view and interact saves both time and cost.

3.1.2 A better user experience

Online video interviewing platforms include "Best Practice Library," "Star Performer" and "Video Library." Applicants not only can search recruitment information but also watch some outstanding recruitment videos and repeated practice through the platform. In the meantime, online video recruitment systems also set up backstage to examine plagiarism and avoid speculation.

3.1.3 Higher quality of recruitment

With a strong language support system, the online recruitment platform can automatically translate the language into a language that the recruiter can understand, which is suitable for global talent recruitment. At the same time, the use of big data and artificial intelligence to identify talent, combines the AI and IO psychology, which finishes the custom evaluation and matches talents with higher quality in the video recording by evaluating some data points such as the candidate's words, tone of voice, facial expressions, gestures and so on.

3.2 Chinese investment value of online video recruitment platform

Based on the Internet, video recruitment platform is both the product of "Internet + human resource management" and the entity enterprise aiming to maximize profits. Its early research technology input cost is extremely high, the technical cost occupies the total cost most part. At present, there is mainly Hirevue and wowzer on the new online video recruitment platform abroad, and there is no similar system professional company in China. Online video recruitment product growth and maturity are the same short as the vast majority of technology products. As a new product stationed in the Chinese market, online video recruitment platform is likely to face a long period of loss status. Some powerful organizations will get more robust market expansion financial support, once break through the bottleneck period, are likely to dominate the online recruitment market in China.

3.3 China barriers to the online video recruitment platform

In the Chinese market, there are economic barriers and administrative barriers in the field of talent recruitment. Economic barriers include economies of scale, market saturation, technical and consumer preference barriers. Due to the full maturity of traditional recruitment methods, the online video recruitment platform is facing with huge scale economic barriers and consumer preference barriers. At the same time, the online video recruitment platform relies on the Internet, which contains the high technical elements that traditional recruitment methods do not have.

Administrative barriers refer to the barriers to entry of new enterprises through administrative means or by laws and regulations. Since the reform and opening up, China has become more and more tolerant to the outside world. On the one hand, it has given financial support to foreign enterprises on fiscal policy, on the other hand, it has continuously lowered taxes and fees. In the course of steady development, China's socialist market economy strives to reduce the administrative barriers of foreign enterprises, which is a positive development for the online video recruitment platform.

From the exit mechanism, the exit barriers of human resources recruitment industry mainly include sunk cost barriers and administrative regulations. From the point of those related product characteristics in online video recruitment platform, its fixed assets is a large portion, and most of the assets do not have the same generality. Assets are not easy to transfer, so It has a higher sunk cost barrier. Also, the online video recruitment platform as an emerging product in China's talent recruitment market has a small negative externality. In the future, the administrative regulations made by the government will not be the main barrier to the withdrawal of the product.

4、 A Case: Development operation and Chinese market analysis of HireVue

4.1 Development of HireVue

HireVue was established in 2004 as one of the first companies to explore online recruitment in the United States and has been committed to online recruitment research. After repeated explorations, HireVue integrated online video interview and recruitment management, Mainly mobile recruitment mode, can make use of AI rating score, and help recruiters search candidates directly, etc. HireVue Insight system can build a machine learning system, based on interview data of more than 3 million candidates, use big data to make a decision and save the tedious links of candidate notification \searrow interview schedule and so on.

On HireVue App, a job interview consists of three parts: the candidate, the recruiter, and the Team Acceleration interview platform. The whole process does not have to be limited to a specific time and place, and special personnel is not required to participate in the interview broadcast.

HireVue's Insight system will score and predict the response videos of all interviewers, based on tens of thousands of indicators. The interviewer will also rate the interviewers according to their own experience. And the two will be combined to select the best candidate. By the way, all the candidate video information will be stored in HireVue's huge database.

4.2 The breakthrough of HireVue's development in China under the "Internet +" background

At present, China's Internet population is over 100 million and still keeps growing, and the everincreasing Internet penetration rate has become a powerful thrust of online video recruitment platform in China. From the infrastructure construction, China's eastern coastal city Internet broadband access network and backbone network are relatively perfect; Internet penetration rate is high. In the western region, except chengdu and chongqing, the broadband access market in most areas is still in its infancy. The imbalance of regional development and the existence of digital divide may hinder the development of HireVue and make it more difficult for HireVue to enter the entire Chinese market.

Network information technology market in our country, the enterprise more focus on the use of various means of expanding the user base, while system maintenance and management are far behind, which caused our country average Internet speed and access speed lags are far behind the United States, Japan, and other developed countries Internet. This is a tricky problem for HireVue, an online video recruitment platform

that requires strong servers and lightning speeds. Also, with the continuous expansion of the Internet to economic, social and cultural fields, Internet and information security issues have been highlighted, and online fishing incidents have increased. The unstable network and information environment will become one of the important problems in the development of online video recruitment platform, such as HireVue.

4.3 The trend forecast of HireVue entering the Chinese market

The development of new products is characterized by high profitability and high risk. Like most new technology products, HireVue products have the risks of the environment, customer, supporting and collaboration, as well as potential risks such as market, policy, and capital. Even with the rich experience in the US market, there is a great technical risk in HireVue because China and international science have a gradient, and the available technology and operating facilities in China are extremely limited.

Success in technology and production does not mean success in new markets. When online video recruitment platform such as HireVue go into the Chinese market, it is difficult to grasp the recruiters to recruitment demand situation and its change, also can not be sure in human resources recruitment market to accept the new product time and the market capacity in the short term. As an "outsider," HireVue, an online recruitment platform for video, lacks effective marketing strategies for the Chinese market. But online video recruitment platform fits the time development theme. In the face of the policy, the risk is lesser, HireVue can Develop the Chinese market easily after the E round of financing, cause HireVue enterprise itself had a great enhancement of economic power.

5、 The China market development path of Online video recruitment

It is estimated that in 2018, the economic benefits brought by Internet recruitment will reach 6.37 billion. With the in-depth development of "Internet +," new recruitment modes and brand communication channels have been continuously innovated and developed. Online video recruitment platform has broad prospects for development, huge market space, and low-cost recruitment benefits can speed up its development from the following aspects.

5.1 Small and medium-sized enterprises as the focus

Small and medium-sized enterprises have a large base. Under the trend of "mass entrepreneurship and innovation" in China, more and more small and medium-sized enterprises will spring up. The human resources management of these enterprises shows the characteristics of limited investment, various types of talents demand, and fast pace of work. The operation mode and features of the online video recruitment platform precisely fit their needs. In China, a large part of small and medium-sized enterprises are in the ascendant phase and have high acceptance of new things. It is less difficult for the online video recruitment platform to develop this market. Behind the huge number of enterprises is hugely lucrative.

5.2 The combination of exogenous financing and endogenous financing

The online video recruitment platform is developing in the Chinese market and requires huge capital investment. However, in the early stage of development, the online video recruitment platform have to

focus on higher-cost external financing due to the lack of funds generated from the results of enterprise operation activities in the short term.Because the rapid rise of technology products, the online video recruitment platform in the following development can use retained earnings for long-term financing.

5.3 Establish multiple interaction patterns

The recruitment method based on the Internet is faced with contradictions based on the transaction mode or the relationship mode in the process of deepening the dependence on technology. Even in the era of "Internet +," online recruitment is not reduced to a management tool. Establishing multiple interactive modes can effectively enhance the exchange of candidates and recruitment enterprises. The multiple interactions between employers, headhunters, candidates and online platforms can fully release and communicate their respective essential needs in a variety of relational chains and effectively match the man-job posts.

5.4 Resource opening and privacy protection coexist

Some developed countries have achieved universal coverage of the social credit system, which can effectively filter false information and match the recruitment of all parties. At the same time, the online video recruitment platform should pay attention to the balance between resource opening and privacy protection. Recruitment of corporate information and interview questions can be opened, the user interview video can be uploaded in the case of interviewers volunteered to share the cloud, interview resources, experience sharing, but at the same time must respect and protect the privacy of each interviewer. Only in this way, online video recruitment can show a strong vitality and vitality in the "Internet +" era of sudden emergence, an effective tool for network recruitment.

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Determinants of Private Domestic Savings in Nigeria (1981-2015).

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Abstract

This study empirically evaluates the determinants of private domestic savings in Nigeria (1981- 2015). Secondary data were sourced from CBN statistical bulletin and bureau of statistics. Hypotheses were formulated and tested using vector error correction model (VECM) and the test for stationarity proves that the variables are integrated in 1(1) order which implies that unit roots do not exist among the variables. There is also long-run equilibrium relationship between the variables and the result also confirms about 29 percent short-run adjustment speed from long-run disequilibrium. The coefficient of determination indicates that about 78 percent of the variations in private domestic savings are explained by changes in its determinants in Nigeria. The results show that per capita income and financial inclusion are major determinants of private domestic savings in Nigeria. The study therefore recommends that concerted and well articulated efforts should be made to make available and affordable credits to productive investments like small scale industries/businesses as they constitute an integral part of the growth and transformation process of an agro based economy like that of Nigeria this will induce employment, increase financial access and income of the various economic agents which will have a spillover effect on private savings. Secondly, since Per capita income and financial inclusion are the important factors that influence private savings in Nigeria, policy makers can promote growth of per capita income by improving productivity of workers and greater effort should be geared towards sustaining or improving on the financial inclusion strategies.

Keywords: Financial Deepening, Financial Inclusion and Savings

INTRODUCTION

BACKGROUND OF THE STUDY

Saving represents a decision not to consume income. Three key motives leading to such a decision include retirement, precautionary, and bequest. There is also target saving for the acquisition of tangible assets. The saving motives are not mutually exclusive. In both developed and developing countries, private saving is critical as it allows households to smooth consumption in the face of volatile incomes besides supporting investments in human and physical capital.

Saving is considered as an important source of financing investment in any country, and a tool for achieving macroeconomic stabilization. A country with low domestic saving rates always achieves low

levels of economic growth. Furthermore, lack of domestic finance leads the country to rely on foreign finance, which might cause external shocks

Adewuyi, Bankole, &Arawomo (2007) argued that a sufficiently strong saving performance is an important precondition for achieving economic growth, macroeconomic balance and financial and price stability. The relationship has become even more crucial with the studies confirming that despite the occasional importance of international flows of capital, the most important factor for a country's investment and economic growth is indeed its own saving.

Domestically generated savings are composed of household savings, corporate savings and government savings. Increases in public sector savings through higher taxes lead to decrease in household and corporate savings and consequently a decrease in productive investments. The marginal propensity for the government to spend is high due to its inability to resist political pressure to spend; hence it may not be relied upon to generate national savings directly. The households and the firms have a crucial role to play in savings generation (Mbuthia, 2011).

Aggregate saving and investment in any economy are dependent on a number of interdependent variables. For economic planning purposes, it is important that economic planners have a true and fair idea about the quantum of saving and investment, the behavior of people towards saving and investment and the method by which saving can be improved for investment decisions (Adelakun ,2015)

There are different motivations to save: life-cycle (to provide for anticipated needs), precautionary, independence, inter-temporal substitution (to enjoy interest), improvement (to enjoy increasing expenditure), enterprise, bequest, avarice and down payment (Karlan and Morduch, 2010). According to the Consultative Group to Assist the Poor (2010), numerous reasons, including low and irregular income and lack of access to financial services, have been posited to contribute to sub-Saharan Africa's (SSA) low formal savings rate. Access to financial services, including deposit or savings accounts, remains a privilege for most of the population (Mutasim and Omran, 2016)

Saving can therefore be vital to increasing the amount of capital available. Meanwhile increased saving is a necessary but not a sufficient condition for investment. Of course, Savings is a strategic variable in the theory of economic growth hence its role as a determinant of economic growth has been emphasized by classical economists like Adam Smith and David Ricardo. In many developing economies particularly Africa, saving and investment are necessary engines for capital formation hence economic growth.

Savings provides developing countries (including Nigeria) with the much-needed capital for investment which improved economic growth. Increase in savings leads to increase in capital formation and production activities that will lead to employment creation and reduce external borrowing of government. Low domestic saving rates may maintain low-growth levels because Harrod Domar model suggested that savings is an important factor for economic growth. Malunond (2007) asserts that depending on foreign sources to finance, investment makes the country highly sensitive to external shocks.

Therefore, domestic savings will continue to be a priority as a source of investment financing in order to minimize vulnerability to international economic fluctuations. (Imoughele and Ismaila,2014). Economic conditions and policies are the key determinants of the level of savings and the stability of the financed system drives its mobilization. Financial sector fragility can impair the effective and efficient mobilization

of savings which of course aid economic growth of Nigeria. For example, the low banks branch network/ spread system not only discourage savings but also impair economic growth and distorts the government aim of enhancing the banking habit of the people (Okere and Ndugbu,2014)

In Nigeria, domestic savings increase continuously in absolute terms from 1981 to 1994 with a continuous increased value of #6562.60million and #8062901.35million respectively (see appendix1). The value decreased to #108490.3million in 1995 and continuously increased to #8062901.35million in 2012. In terms of the growth rate, national savings has being fluctuating and declining. For example in 1982 the growth rate was 14percent and 13

It further soared to 34.03 percent in 1987 and decreased to 2.4 percent in 1989, it rose to 54.3percent in 1993, but it fell to -2.2 percent in 1995. The growth rate of domestic savings stood at 38.8 percent, 21.6 percent and 23.4 percent in 1998, 2004 and 2012 respectively (see appendix 1).

Available data also shows that the saving culture in Nigeria is very poor relative to other developing economies. For instance, during the period 1981 to 1990, domestic saving averaged 8.31 percent of GDP and decreased to average of 7.81 percent from 1986 to 1994. However, with the distress in the financial sector of the 1990s, the rate of aggregate saving declined significantly. The distress syndrome resulted in a significant fall in domestic saving in the period 1995 to 2004, with the saving to GDP ratio dropping to 5.63 percent.

Obadan and Odusola (2001) asserted that the low level of savings in Nigeria is as a result of high incidence of poverty and low level of disposable income, under developed savings channels, reflecting underdeveloped capital markets, conspicuous consumption, and unfavourable economic environment characterized by high unemployment and inflation.

However, the average saving to GDP ratio between 2006 to 2015 figure stood at 13.57 percent. This may be attributable to the consolidation and reconstruction of the financial sector in Nigeria. From the foregoing, there is an urgent need to encourage Nigerians to change their current attitude towards saving.

STATEMENT OF THE PROBLEM

Although a vast empirical literature has shed light on various aspects of saving behaviour, several crucial questions remain unanswered with regard to the relevance of policies in raising the saving rate vis-à-vis the non-policy determinants of saving. From the perspective of policies, there is need to know the following: What is the magnitude and direction of these variables on saving? How effective are growth-enhancing policies such as macroeconomic stability and higher income growth in raising the saving rate? What is the effectiveness of financial development in increasing domestic saving? Is there a role for fiscal policy in increasing national saving? What is the impact of interest rate on total saving?

As earlier stated, available data show that the saving culture in Nigeria has been very poor relative to other developing economies like Malaysia, South Korea, Taiwan, Singapore etc. For instance, during the period 1981 to 1990, domestic saving averaged 18.31percent of GDP. However, with the distress in the financial sector of the earlier 1990s, the rate of aggregate savings declined significantly. The distress syndrome resulted in a significant fall in domestic saving in the period 1991 to 1994, with the saving to GDP ratio dropping to 6 percent. By 2004, the figure stood at 6.4 percent. These suggest that in spite of all the efforts

by the regulatory authority to build up the level of savings through relevant policy options, in general, savings appear not to be significantly responsive. The question that demands an answer is: what really determines domestic savings in Nigeria?

The importance of the present paper stems from the fact that increased saving rate is of crucial importance for achieving macroeconomic stabilization, sustainable development and poverty-reducing growth in developing countries. In addition, savings that are generated within the national economy provide the means for the financing of domestic fixed capital formation, which in turn, affects economic growth potential. Understanding of the fundamental determinants of domestic private saving in Nigeria represents critical importance in order to formulate policies to raise the domestic saving rate

OBJECTIVES OF THE STUDY.

The main objective of this study is to find out the major determinants of private domestic saving in Nigeria over the period (1981-2015). The specific objectives include to;

- (a) Determine the effect of per capita income on private domestic saving rate in Nigeria.
- (b) Find out the effect of deposit rate on private domestic savings in Nigeria.
- (c) Determine the effect of financial deepening on private domestic saving in Nigeria
- (d) Establish the effect of inflation on private domestic savings in Nigeria
- (e) Determine the effect financial inclusion in private domestic savings in Nigeria

RESEARCH QUESTIONS

- (a) To what extent does per capita income determine private domestic savings in Nigeria?
- (b) To what extent does deposit rate affect private domestic savings in Nigeria?
- (c) To what magnitude does financial deepening really determine the rate of private domestic savings in Nigeria?
- (d) To what extent does inflation affect the rate of private domestic savings in Nigeria?
- (e) To what magnitude does financial inclusion affect the private domestic savings in Nigeria?

RESEARCH HYPOTHESES.

H01: Per capita income does not have a significant impact on private domestic Savings in Nigeria.

H02: Interest rate does not have a significant impact on private domestic

Savings in Nigeria.

H03: Financial deepening does not have a significant impact on private domestic Savings in Nigeria.

H04: Inflation does not have a significant impact on private domestic savings in Nigeria.

H0₅: Financial inclusion does not have a significant impact on private domestic Savings in Nigeria.

REVIEW OF RELATED LITERATURE

PREAMBLE

This section reviews existing literature related to the subject matter of this study. Essentially, the reviews are packaged in three separate sub-sections including conceptual review, theoretical review and empirical review. In the course of this review, efforts were made to link the objectives of the study o existing literature to enable us do a detailed discussion of findings in this research

CONCEPTUAL FRAMEWORK

To Nkah (1997), savings is seen as the amount of income per time that is not consumed by economic units. Accordingly, Samuelson at el (1998) defined savings as income minus consumption following from 'the above, savings can be made by individuals (personal or private saving) or by corporate organizations such as firms (corporate savings or retained savings). Personal savings is that part of disposable income that is not consumed, while corporate saving is that part of firm's profit that is not distributed as dividends to shareholders. Therefore, for a country, the total supply of available savings is simply the sum of domestic savings and foreign savings.

However, domestic savings could be further broken into two components, which include government or public sector savings and private domestic savings. Government savings originates from surplus budgeting, but very few countries make part of their public sector savings from savings or profit of the government owned enterprise. There are also two aspects of private domestic savings, which include corporate savings and household savings. Again foreign savings also come into two basic forms such as; official foreign savings or foreign aid, and private foreign savings.

Following McKinnon (1973) and Shaw (1973) argued that for the typical developing country, the net impact of a change in real interest rate on saving is likely to be positive. This is because, in the typical developing economy where there is no robust market for stocks and bonds, cash balances and quasimonetary assets usually account for a greater proportion of household saving compared to that in developed countries. In addition, in an environment where self-financing and bank loans constitute the major source of investment funds, accumulation of financial saving is driven mainly by the decision to invest and not by the desire to live on interest income.

Given the peculiarities of saving behaviour, in addition to the fact that the bulk of saving comes from small svers, the substitution effect is usually larger than the income effect of an interest rate change. Lewis (1955) noted that people would save more if saving institutions were nearer to them than if they were farther. As a result, a negative relationship is assumed to exist between population per bank branch and household financial saving. However, whether increased financial intermediation itself significantly increases the overall propensity to save depends also on the degree of substitution between financial saving and other items in the household's asset portfolio.

Thirlwall (2002) identified three basic types of domestic private savings, namely: voluntary, involuntary, and forced savings. Voluntary savings relate to the voluntary abstinence from consumption by private persons, out of personal disposable income, and by companies out of profits, and the government. However, voluntary savings depend on the capacity to save and the willingness to save. The capacity to save depends

on three main determinants: the level of per capita income (PCI); the growth of income, and the distribution. The willingness to save depends, in turn, on: the rate of interest; the existence of financial institutions; the range and availability of financial assets, and the rate of inflation.

According to Keynes (1936), the major determinant of both country's level of consumption and savings, is that country's national income. He therefore opined that the higher the income, the high the level of consumption and saving. He equally maintained that-even at the individual level, a person's income daily determines to a large extent his consumption and savings. Keynes recognized this when he found a positive relationship between consumption and person's disposable income That is,

C = F(Yd) and

S = Y-C

Where;

C = Consumption

Yd = disposable income

Y = consumer's level of income.

However, according to Macklinon (1973), savings is not determined by income as postulated by Keynes (1936), but, it is determined by real interest rate. In his analysis, he viewed low interest rate as a cause of low savings, which means that firm business enterprises, are discouraged to invest funds through the formal banking system. He equally admitted that-high real interest rate is seen as a strengthening factor to both market institution and the level of savings.

Financial Inclusion will help pave way for sustainable economic development by providing financial services to individuals and communities that traditionally have limited or no access to the formal financial sector as evidenced in Nigerian rural dwellers.

THEORETICAL FRAMEWORK

Savings as a subject has received immense publishing from different authors and schools of thought. Savings and consumption are normally considered together in most of the theories of savings, due to the fact that if a household makes a decision to consume, it is in effect making a decision not to save the consumed amount (Mbuthia, 2011). Several models are used to explain motivations to save: life-cycle (to provide for anticipated needs), precautionary, independence, inter-temporal substitution (to enjoy interest), improvement (to enjoy increasing expenditure), enterprise, bequest, avarice and down payment (Karlan&Morduch, 2010).

Absolute Income Hypothesis (Keynesian Theory)

Aggregate consumption has featured in macro-models since (Keynes, 1936) and is especially important for growth in a transitional economy. Household's current consumption expenditure is a positive function of real current disposable income. As the income increases, the increment is partly consumed and partly saved for purposes of financial security in periods of unemployment, illness, death of bread winner or for investment so as to enhance future income. The absolute income hypothesis is a short run theory and makes the assumption that marginal propensity to consume (MPC) is between zero and one. MPC declines with

increase in income, implying that marginal propensity to save increases as income increases. The implication of this is that low income families save a lower percentage of their income as compared to high income families.

Relative Income Hypothesis

Duesenberry (1949) contended that the utility of consumers depended not so much on their absolute income (Keynes' view), but rather on their relative income, both current income relative to previous income and current income relative to income of others in society with whom the consumer feels in competition with. According to relative income hypothesis, a household's consumption expenditure is a function of the relative income of the household. When a household's income falls, the household dis-saves or borrows in order to prevent a large fall in their living standards and also to maintain their living standards at par with their peer groups. This is an important distinction between absolute income hypothesis and relative income hypothesis. The short run APC is greater than the long run APC according to relative income hypothesis. This implies that the short run average propensity to save is smaller than the long run average propensity to save.

According to the relative income hypothesis an increase in income is always proportional to the increase in household consumption expenditure irrespective of whether the increase in income is small or large.

The Life-Cycle Model (LCM)

The life-cycle hypothesis is the principal theoretical underpinning that has guided the study of savings behavior over the years. It is the theory upon which this paper is based. Each of the determinants of saving is articulated in the context of the life-cycle hypothesis.

Income

The principal assumption of the life-cycle hypothesis is that an individual seeks to maximize the present value of lifetime utility subject to the budget constraint. The budget constraint is equal to the current net worth plus the present value of expected income from work over the remaining working life of the individual.

Growth

The life-cycle model predicts that an increase in the rate of growth of income per capita will lead to an increase in the aggregate saving rate. This is because it increases the lifetime resources and saving of the younger population relative to that of the older one (see Modigliani, 1970; Madison, 1992; Bosworth, 1993; and Carroll and Weil, 1994). However, controversy is still raging as to its structural interpretation, since some see it as evidence that saving drives growth through the saving-investment link and others as evidence that it is growth that drives saving.

Interest Rate

The life-cycle model predicts that a higher interest rate increases the current price of consumption vis-àvis the future price, thus leading to an increase in saving. This is the substitution effect. If on the other hand, the household is a net lender, an increase in interest rate will increase lifetime income, and so increase consumption and reduce saving. This is the income effect. Thus, saving will have a positive relationship with interest rate only when the substitution effect surpasses the income effect. Some authors, including McKinnon (1973), Shaw (1973) and Athukorala et al (2004) have argued that the relationship between real interest rate and saving is positive for a developing economy. They hinge their argument on the fact that the financial markets of these countries are not well developed. In an environment where self-financing and bank loans make up the bulk of investment funds, accumulation of financial saving is determined more by the desire to invest than the desire to live on interest income. As a result, the greater part of household saving will be in the form of cash and near-money assets. Thus, the substitution effect will usually be much greater than the income effect of an interest rate change.

Inflation and Macroeconomic Uncertainty

The impact of inflation on saving in the life-cycle model is through its role in determining the real interest rate. This is based on the assumption of the absence of real balance effect of inflation and the non-existence of money illusion in people's saving behaviour. This relates to the role of inflation in determining saving. In the standard LCM, the only impact of inflation on saving is through its role in determining real returns to saving (the real interest rate). This postulate is based on the implicit assumptions of inflation neutrality (the absence of money illusion) in saving behavior and the absence of the real balance effect of inflation.

Financial Development

Until recently, financial development was assumed to enhance the saving rate. Financial deepening relates to the overall increase in the ratio of money supply to GDP or some price index and is a measure of how much opportunity for continued growth exists in an economy.

It consists of elimination of credit ceilings, interest rate liberalization, easing of entry for foreign financial institutions, enhanced prudential guidelines and supervision, and the development of capital markets. Loayza et al (2000) find that financial development has led the private sector to increase the durable goods component of their assets. The effect of financial development on saving rates can be separated into a direct short-run impact, which is usually negative, and an indirect long-run impact, which is generally positive However, whether increased financial development itself significantly increases overall propensity to save depends on the extent of substitution between financial saving and other items in the household's asset portfolio.

EMPIRICAL REVIEW.

Many studies have been carried out to examine the determinants of savings. For example, (Imoughele 2014) evaluated the determinant of private savings in Nigeria (1981- 2012). The study used cointegration and Error Correction Mechanism to determine the relationship between private savings and internal and

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external factors. Their results show that income per capital, inflation rate, term of trade and financial deepening are significant determinants of private savings in Nigeria.

Antai et al, (2015) worked on the Estimation of the Short Run and Long Run Determinants of Domestic Savings Rate in Nigeria (1970-2008) Using a vector and error correction model (VEC), their paper showed that Nigeria's national savings rate decisions are positively influenced by per capita income and economic growth, and negatively influenced by financial sector development and bank density index. And savings interest rate, openness to trade, terms of trade, and inflation are not significant determinants of savings rate in Nigeria, given the historical data set.

Adelakun, (2015) Investigated the Determinants of Savings and Investment in Nigeria. The study made use of time series data spanning twenty-nine years using error correction model. The result showed a positive relationship between savings, investment and economic growth in Nigeria. Of the determinants of savings considered in the study, inflation rate contributes negatively to saving, while interest rate positively affect saving.

Uremadu (2007) investigated the core leading determinants of financial savings in Nigeria using ordinary least square (OLS) econometric framework. The results shows positive and significant influence of gross domestic product per capita, interest rate spread, broad money supply, and debt service ratio on savings while real interest rate and domestic inflation rate have negative influence on the level of savings.

Gobna and Nuruden (2009) employed error correction analysis to ascertain the long run determinants of savings in Nigeria during the period 1981 to 2007. The findings showed that financial deepening, bank density, real interest rate inflation and real income per capital are the major determinants of savings in Nigeria.

Wafure (2012) used co-integration and Error Correction Mechanism to determine the relationship between financial sector reforms and private savings. The estimated results showed that lagged value of private savings, consumer price index, savings deposit rate, Income per capita showed a significant and inverse impact on private savings while financial liberalization and income growth have direct and significant impact on private savings but wage rate and foreign savings were insignificant.

The study of Okere and Ndugbu (2014) on Macroeconomic Variables on Savings Mobilization in Nigeria using Ordinary Least Square and cointegration to determine the effect of the selected macroeconomic variables on savings mobilization in Nigeria. The result of the overall statistic showed that there is a positive and significant impact between the selected macroeconomic variables and domestic savings mobilization in Nigeria. But specifically, financial deepening seemed to have a greater impact on savings mobilization in Nigeria. Inflation and exchange rate revealed an inverse relationship with domestic saving mobilization in Nigeria.

Recent study of Mutasim (2016) investigated the Determinants of Saving Rate in Sudan, (1990-2013) taking into consideration real disposable income, real deposit rate, and age dependency ratio as explanatory variables. The OLS technique is adopted for conducting the regression analysis. The main results obtained signified that age dependency ratio reduces the saving rate, while real deposit rate and real disposable income impact positively. Each of the explanatory variables is statistically significant at 1% level. The saving rate in Sudan during the period under study is found to be more responsive to age dependency ratio followed by real deposit rate, and lastly real disposable income.

Also the study of Onwuasoeze and Kirori (2016) that investigated the determinants of private savings in Kenya over a period of 21 years from 1993 to 2013 considered the independent variables to include dependency ratio, per capita income, financial deepening, inflation rate, and real interest rate. The model was subjected to diagnostic tests for OLS estimation. All the other determinants of the private saving considered in the study were statistically significant according to theoretical expectations except for the real interest rate which was statistically insignificant.

SUMMARY AND RESEARCH GAPS

A review of previous literature in the preceding section shows that studies that have been carried out in Nigeria on savings using time series data approach have majorly focused on macro-economic variables such as Inflation, interest rates, Per Capita GDP and they have showed mixed results. For example the study of Adelakun, (2015),Wafure (2012),Okere (2015),Uremadu (2007) etc. Few studies have also focused on financial deepening as a determinant of saving and no study has ever looked the financial access (financial inclusion). Furthermore, a close scrutiny of all the study variables shows that there is a disparity between the different findings of the different variables and hence the study aims at filling this gap.

RESEARCH METHODOLOGY

Preamble

Research methodology shows the steps taken by the researcher to arrive at the results (Nnamocha, 2005). The methodology deals with model specification, data requirements, sources of data and method of data analysis.

Research Design.

This study utilized the Ex post facto design. It is a quasi-experimental study examining how an independent variable, present prior to the study in the participants, affects a dependent variable. An ex post facto research design is a method in which groups with qualities that already exist are compared on some dependent variable

Sources of Data

The data for this study is secondary and was collected from the National Bureau of statistics and Central Bank of Nigeria (CBN) statistical bulletin from 1981- 2015. This study looks at the inputs and output of the banking sector and how this relationship affects the entire economy of Nigeria.

The definition of inputs and outputs for the banking sector are derived from the intermediary role that banks play in the economy.

Method of Data Analysis

The analytical framework of this study includes pre estimation analysis such as descriptive statistics and stationarity test. This is to reveal the behaviour of the data on the variables. The stationarity test will investigate the stationarity of the variables; non stationarity could lead to spurious regression results. Such spurious relationship between/ among variables may be evident in time series data that exhibit non-stationary. The test for the presence of long-run equilibrium relationship is carried out based on the Johansen's (1991) multivariate cointegration technique. The error correction model (ECM) is applied to tie the short-run dynamics of the co-integrating equations to their long-run statics dispositions.

Model Specification

The model encompassed the determinants of private domestic savings. Empirical implementation of the model made use of the domestic private savings data covering 34 years (1981-2015). The model encompassed **The Life-Cycle Model (LCM)** and **Absolute Income Hypothesis (Keynesian Theory)** as well as more recent and less conventional models. Particularly, the study has adopted and modified the work of Nwachukwu (2007) (the growth rate of disposable income and the real interest rate on bank deposits, Fiscal balance and the degree of financial depth in Nigeria.) to come up with a more robust model in explaining the determinants of private domestic savings in Nigeria

In line with the above discussion, the model adopted by this study is specified as follows:

Private domestic savings (PDS)= f (PCI, INF, BDR, FID, FCL).....(i)

This can be stated in a mathematical or statistical function as:

 $PDS = \alpha_0 + \alpha_1 PCI + \alpha_2 INF + \alpha_3 BDR + \alpha_4 FID + \alpha_5 FCL \dots (ii)$

However, this equation (ii) can now be stated in econometric form to account for the stochastic variables $PDS = \alpha_0 + \alpha_1 PCI + \alpha_2 INF + \alpha_3 BDR + \alpha_4 FID + \alpha_5 FCL + \mu$(iii) Where:

PDS = Private Domestic Savings

PCI= Per Capita Income

INF = Inflation

BDR = Bank Deposit Rate

FID = Financial Deepening (Proxy of ratio of broad money supply to GDP)

FCL= Financial Inclusion

 μ = Stochastic variable

 $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5 = \text{Coefficients}$

The appriori expectation is that all the independent variable; PCI, INF, BDR, FID, and FCL will have a direct relationship with the dependent variable PDS.

This is thus stated; $\alpha_1, \alpha_4, \alpha_5, >0, \alpha_3, \ge 0, \alpha_2 < 0.$
DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

The analytical framework of this study consists of six basic steps carried out on the models specified above. They include; presentation of data descriptive statistical analysis, unit root test, diagnostic test, ordinary least square regression method, vector error correction mechanism (VECM), co-integration test.

DESCRIPTIVE STATISTIC

Table 4.1 Descriptive Statistic Result

	PDS	BDR	FCL	FID	INF	PCI
Mean	2072.166	12.25433	11279.74	17827.15	19.37057	52233.09
Median	200.0651	10.09250	4855.200	4189.250	11.60000	47326.61
Maximum	12008.21	28.02000	82765.00	94144.96	72.80000	85872.49
Minimum	6.562600	6.302815	19.72322	94.32502	5.400000	36583.81
Std. Dev.	3457.948	5.145718	17401.94	28092.36	17.24154	14774.34
Skewness	1.684234	1.262481	2.833429	1.688211	1.599538	0.891072
Kurtosis	4.595928	4.171395	11.34540	4.405487	4.596764	2.516001
Jarque-Bera	20.26144	11.29858	148.3985	19.50612	18.64295	4.973342
Probability	0.000040	0.003520	0.000000	0.000058	0.000089	0.083186
Sum	72525.80	428.9014	394790.7	623950.4	677.9700	1828158.
Sum Sq. Dev.	4.07E+08	900.2660	1.03E+10	2.68E+10	10107.21	7.42E+09
Observations	35	35	35	35	35	35

Source: Result extracted from the Eviews 7 Output.

The result above shows the mean values of the PDS, BDR, FCL, FID, INF and PCI

Variables are 2072.166,12.25433, 11279.74, 17827.15,19.37057 and 52233.09 respectively. The median of the series are 200.065, 10.09250,4855.200, 4189.250,and 11.60000, 47326.61and respectively for PDS, BDR, FCL, FID, INF and PCI variables. It should be noted that the median is a robust measure of the centre of the distribution that is less sensitive to outliers than the mean. The maximum values of each of the series in the current sample are 47326.6for PCI, 4855.200for FCL, 4189.250 for FID and 200.065 for PDS respectively. The standard deviations which are a measure of dispersion spread in each of the series are3457.948 for PDS, for 5.145718BDR,17401.94 for FCL, 28092.36 for FID, 17.24154 for INF andfor14774.34PCI. Additionally, the descriptive analysis was also furnished with Skewness and Kurtosis of all the variables of interest. The Skewness measures symmetrical property of the histogram while the kurtosis measures the height and the tail shape of the histogram. The yardstick for measuring the Skewness is how closer the variable is to the zero (0) and for the kurtosis is how closer the variable is to the zero (0) and for the kurtosis, all the variables (PDS, BDR, FCL, FID and INF that have relatively asymmetrical distribution. For the kurtosis, all the variables (PDS, BDR, FCL, FID and INF that have

except PCI can be regarded as leptokurtic because they have values greater than 3.PCI is playkurtic because its value is less 3 (2.516001)

The Jarque-Bera statistic, which is a test statistic for testing whether the series is normally distributed, measuring the difference of the skewness and kurtosis of the series. The probability values of the Jarque-Bera statistic for all the explanatory variables are all significant at a 5% confidence level except PCI that is not normally distributed. In other words, the results indicate that PDS, BDR, FCL, FID and INF are normally distributed but PCI may not be normally distributed at 5% significant level.

-						
	Variable	Test Critical Value@ 5%	ADF Test Statistic	Order of	Comment	
		Level		Integration		
	LOGPDS	-7.437975	-2.957110	1(1)	Stationary	
	LOGBDR	-8.521614	-2.960411	1(1)	Stationary	
	LOGFCL	-6.703948	-2.967767	1(1)	Stationary	
	LOGFID	-6.290356	-2.960411	1(1)	Stationary	
	LOGINF	-8.009910	-2.960411	1(1)	Stationary	
	LOGPCI	7.533191	-2.957110	1(1)	Stationary	

UNIT ROOT TEST ANALYSIS Table 4.2: Augmented Dickey-Fuller (ADF) Root Unit Result

Source: Extracted from Eview

In other to avert the occurrence of spurious results, there is need to test for the presence of unit root in order to ensure that the parameters are estimated using stationary time series data. To achieve this, the Augmented Dicky-Fuller (ADF) is used. The essence of the ADF tests is the null hypothesis of non stationarity. Comparing the ADF test statistics with the 5% critical values, the result of the unit root test reported in table 4.3 above indicated that all the variables are stationary at first differencing. Hence, the series are all integrated serious of order 1(1). This is evidence by the fact that the Absolute Values of the ADF test statistics are all greater than the critical values at 5% level of significance. After stationarizing the variables, the data can then be tested whether these variables are cointegrated or not by applying Johansen Cointegration procedure to test for long – run relationship between the dependent and independent variables.

JOHANSEN CO-INTEGRATION TEST TABLE 4.3 Johansen Co-Integration Test Result

Sample (adjusted): 1984 2015 Included observations: 32 after adjustments Trend assumption: Linear deterministic trend Series: PDS BDR FCL FID INF PCI Lags interval (in first differences): 1 to 1

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.764459	138.6020	95.75366	0.0000
At most 1 *	0.712474	92.33411	69.81889	0.0003
At most 2 *	0.483997	52.44796	47.85613	0.0174
At most 3 *	0.400545	31.27540	29.79707	0.0336
At most 4	0.286406	14.89990	15.49471	0.0613
At most 5 *	0.120306	4.101789	3.841466	0.0428

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

Source: E-view 7.0 Package

Since the unit root test shows that all the variables are stationary at first order difference 1(1), we therefore test for co-integration among these variables by employing the Johansen co-integration test. The result of the test is shown in table 4.3 below. The result shows that there exist four (4) co-integrating equations at 5% level of significance. This is because the Trace Statistic is greater than critical values at 5%. This shows that there is long run relationship between Private domestic savings and all the explanatory variables. The result indicates that, in the long run; the dependent variables can be efficiently predicted using the specified independent variables. Hence, error correction model can be estimated.

Variables	Coefficient	Std. Error	t-Statistic	e Prob.
С	-32.87944	6.648272	-4.945561	0.0000
LOG(BDR)	-0.790709	0.407215	-1.941750	0.0640
LOG(FCL)	0.379019	0.131091	2.891274	0.0080
LOG(INF)	0.328711	0.187578	1.752394	0.0925
LOG(PCI)	14.38520	2.834734	5.074621	0.0000
LOG(FID)	-0.047381	0.507789	-0.093308	0.9264
ECM(-1)	-0.297347	0.153983	-2.931037	0.0554
R-squared	0.782375	Mean depen	dent var	1.714520
Adjusted R-squared	0.727969	S.D. dependent var		0.410115
S.E. of regression	0.213902	Akaike info criterion		-0.050918

ERROR CORRECTION MODEL (ECM) Table 4.4. Error Correction Model (ECM) RESULT

Sum squared resid	1.098098	Schwarz criterion	0.272886
Log likelihood	7.789226	Hannan-Quinn criter.	0.054634
F-statistic	14.38027	Durbin-Watson stat	1.692169
Prob(F-statistic)	0.000001		

The result shows that the coefficient of error correction mechanism (ECM) is negative -0.2973983 and statistically significant which is necessary condition for the variables to be co-integrated. This shows that about 29.73 per cent disequilibria in Nigeria's private domestic savings in previous year are corrected for in the current year. Or it reveals that the speed of adjustment between the short-run and long-run realities of the co-integrating equations is 29.73 per cent. Again, the significance of the ECM is an indication and a confirmation of the existence of a long run equilibrium relationship between Nigeria private savings and all the explanatory variables.

Global Statistical Results Analysis

The econometric property of the estimated equation shows that the global utility or the overall goodness of fit is high with an F- statistics of 14.38027. R^2 is 0.782376 or 78.23%. This implies that, at level series, about 78.23% of the total variations in the private domestic savings (PDS) are explained by the changes in the determinants of savings in Nigeria – BDR, FID, FCL and PCI. The Log-likelihood ratio, Akaike information criterion and Schwarz Bayesian criterion statistic all showed that the model has good forecasting power.

Relative Statistics of the Estimated Model

From table 4.5, the relative statistics of the estimated model shows that the two explanatory variables, financial Inclusion (FCL) and Per Capita Income (PCI) have positive relationship with the private domestic savings (PDS). This means that a 1% increase of PCI and FID bring about 38% and 143% respectively increase in the level of PDS in Nigeria.

Table 4.5TESTS OF HYPOTHESES.

Variables	T-Statistic	Prob.Value	Observation	Decision
LOGBDR	-1.941750	0.0640	p-value>0.05	Accept null
LOGFCL	2.891274	0.0080	p-value < 0.05	Reject null
LOGFID	-0.093308	0.9264	p–value> 0.05	Accept null
LOGINF	1.752394	0.0925	p-value>0.05	Accept null
LOGPCI	5.074621	0.0000	p -value< 0.05	Reject null

Source: Extracted from Eviews 7.0

This sub-section presents the result of hypothesis testing. Null hypothesis to be tested is that the explanatory variables (BDR, FCL, FID, INF and PCI) used in the model have no significant impact on private domestic

savings in Nigeria. If the t-statistic of any explanatory variable is less than p-value at 5% significance, such variable is said to have significant impact on savings mobilization, and if otherwise it has no significant relationship.

As earlier observed, the F-statistic proved that variables entered have the capacity to determine the level of private domestic savings in Nigeria.

However, we will go on and test for individual contributions of each of these variables.

From the table 4.6 above, it can be observed that deposit rate, financial deepening, inflation and inflation rate do not significantly contribute to private domestic savings in Nigeria while financial inclusion and per capita income significantly contribute to private domestic savings in Nigeria. Alternatively, the five hypotheses can be tested one after the other.

H01: Per Capita income does not have a significant impact on private domestic

Savings in Nigeria.

Based on the table 4.6 above and the decision criteria, we reject the null hypothesis and accept the alternative hypothesis and conclude that per capita income has a positive and significant impact on private domestic savings in Nigeria. The implication of this result is that the higher the economic position of the household, the higher the level of savings. This finding is consistent with the life –cycle hypothesis, Gobna et al (2009),**Imoughele et al (2014)** and Nwachukwu et al (2007)

H02: Interest rate does not have a significant impact on private domestic Savings in Nigeria.

From table 4.6 above and the decision rule as stated in section three, H0 is accepted thereby leading to the rejection of the H1 and conclude that Interest rate does not have a significant impact on private domestic savings in Nigeria

H03: Financial deepening does not have a significant impact on private domestic Savings in Nigeria.

From the table 4.6 above and the decision criteria, we therefore accept the null hypothesis and reject the alternative hypothesis and conclude that financial deepening does not significantly impact on private domestic savings in Nigeria.

H04: Inflation does not have a significant impact on private domestic savings in Nigeria.

. Here, H0 is accepted thereby leading to the rejection of the H1 and conclude that Inflation does not have a significant impact on private domestic savings in Nigeria.

H05: Financial inclusion does not have a significant impact on private domestic Savings in Nigeria.

Again, H0 is rejected thereby leading to the acceptance of the H1 and conclude that financial inclusion has significant impact on private domestic savings in Nigeria.

In inclusion, from the table 4.6 above, it can be observed that deposit rate, financial deepening and inflation rate do not significantly contribute to private domestic savings in Nigeria while financial inclusion and per capita income significantly contribute to private domestic savings in Nigeria.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

SUMMARY.

In this study, "**The Determinants of Private Domestic Savings in Nigeria**" we investigated the determinants of private savings in Nigeria between 1981 through 2015. The main objective of this study is to find out the major determinants of private domestic saving in Nigeria over the period (1981-2015). The specific objectives include; to determine the effect of per capita income on private domestic saving rate in Nigeria, to find out the effect of deposit rate on private domestic savings in Nigeria and others

In order to achieve the objective of the study, an econometric model was formulated; secondary data was sourced from CBN Statistical bulletin (different series). Private savings was regressed on financial deepening, deposit interest rate, per capita income, financial inclusion and inflation rate. These variables were included in our econometric model based on review of past studies. Prior to the model estimation, time series properties of the data were established using Augmented Dickey-Fuller test for unit roots. All the variables including the private domestic saving, financial deepening and per capita income are found to be stationary at first levels I(1) hence, prompting a test for cointegration. The result from co-integration test showed presence of long run relationship between dependent and all explanatory variables in the model. The Error Correction Model (ECM) was also used to tie the short-run dynamics of the co-integrating equations to their long-run statics dispositions. The Error Correction Mechanism was properly and appropriately signed with a coefficient of -0.297347 thus indicating that about 29.73% of disequilibrium is corrected yearly by changes in savings determinants.

The normality test indicates that the parameters are normally distributed given Jargue – Bera values and probability values of all the variables (except PCI) at 5% level of significance.

From the Global Statistical Results Analysis, the coefficients of financial inclusion and per capita income are found to be statistically significant at 0.05 level of significance. Again, the econometric property of the estimated equation shows that the global utility or the overall goodness of fit is high with an F- statistics of 14.38027 and probability value of 0.00001. R^2 is 0.782375 or 78.23% and the adjusted R^2 is 72.7%. This implies that about 78.23% of the total variations in the private domestic savings (PDS) are explained by the changes in the determinants of savings in Nigeria – BDR, FID, FCL and PCI. The Durbin – Watson statistic for autocorrelation was 1.692169. This is closer to 2 than 0, which indicates absence of autocorrelation

The five hypotheses tested revealed that only the financial inclusion and per capita income were statistically significant to determine private domestic savings in Nigeria. This finding implies that the various initiatives adopted by the Nigeria Central Bank in the last few years to strengthen and further develop financial markets and institutions contributed to an increase the private savings. This finding is in line with life – cycle hypothesis and that of Gobna and Nurudeen (2009) Nwachukwu and Egwaikhide (2007) and Wafore (2012)

The result shows that inflation rate has inverse relationship though insignificant to Nigeria private domestic savings.

The study also revealed the existence a positive but insignificant relationship between interest rate and private savings in Nigeria. The implication of this study is as a result of poor interest rate and the dominants of informal sector in granting credit facility to various economic agents. The positive effect of deposit interest rate shows that high interest rate will encourage people to savings more since they will earn higher return in feature all things been equal.

CONCLUSION

This research work examined the determinants of private domestic savings in Nigeria within the period of 1981- 2015. The significance of the financial inclusion and the per capita income variables in the private domestic savings model is an indication that savings would only increase based on the financial inclusion (the number, the access and cost of product and people integrated in the banking sector) and on the economic position of the household. The implication of this result is that the higher the economic position of the household, the higher the level of savings. Also an enhancement/ improvement in the financial sector is very crucial as it leads to increased private domestic savings mobilization which is needed for investment that will encourage economic development

RECOMMENDATIONS

In the light of the empirical findings, which emerged in this study, the following recommendations are made.

- 1. Per capita income and financial inclusion are the important factors that influence private domestic savings in Nigeria. Policy makers can promote growth of per capita income by improving productivity of workers.
- 2. Concerted and well articulated efforts should be made to make available and affordable credits to productive investments like small scale industries/businesses as they constitute an integral part of the growth and transformation process of an agro based economy like that of Nigeria this will induce employment, increase financial access and income of the various economic agents which will have a spillover effect on private savings.
- 3. The monetary authorities should as matter of urgency roll out plans to combat the current recession in order fight the two evils of inflation and unemployment in the Nigeria economy. Since inflation has negative though insignificant influence on domestic savings in Nigeria.

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Management of Curriculum Change: A Mechanism for Ensuring Continuous Academic Improvement in Ghanaian Universities

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Abstract

Effective collaboration in the curriculum change effort remains a challenge in higher education, in particular, with comprehensive curriculum reform or change. Curriculum modification to existing courses or content will not always lead to the desired reform even though a collaborative approach has been the foundation of the process. Comprehensive and collaborative curriculum change requires a full examination of how academics conceive their role and how the curriculum itself is defined, analyzed, and changed. Through a systematic review of literature, the researchers were able to create a contextualized emergent model for curriculum change management for Ghanaian universities derived from experience and educational policies. It emerged from the review of literature that a collectively shared quiding vision for an effective curriculum change provided a strong foundation for the comprehensive curriculum review process; Embracing curriculum as a shared responsibility among faculty and administration led to widespread participation; The collaboration of various groups within the institution in the process promoted organizational change; Cultural issues regarding people and organizational structure served as barriers to the collaboration process, simultaneously the curriculum team's sense of community strengthened the curriculum review process. This position paper, therefore, recommends that the Ministry of Education in conjunction with the Ghana Education Service should ensure that the practice of curriculum change is highly decentralized to reflect local concerns. Thus, the decentralization of the process would be tailored towards the local needs of the area. This would make education more meaningful and relevant to students.

Keywords: *Curriculum, Curriculum Change, Higher Education, Continuous Improvement, Curriculum Reform, Institutionalization.*

Introduction

Within the context of higher education, a curriculum or a program of study is a pivotal issue in the relationship between students, teaching staff and the university. However, different stakeholders experience the curriculum (as a program of study consisting of several courses) from their point of view and are often only aware of a part of all important aspects building the curriculum. Therefore, curriculum issues are complex to discuss, especially, when it comes to the concept of curriculum change that has diverse perspective from different stakeholders. Clear and useful tools that describe all curriculum building blocks and their relationships can be helpful to stimulate all stakeholders to tackle educational issues taking into account the entire curriculum perspective.

In the 1990s, democracy in schools was welcomed by all, including teachers, who then had to face curriculum changes, training for curriculum changes and bringing the education of the previously disadvantaged communities on par with the rest of the world (Mudau, 2014). The process was difficult to manage, as change had to start with the drafting of policies and the setting up of structures and legislation. Despite the opportunities brought about by educational democracy and the need for improvement in education standards, the conditions in many schools today still need serious improvement (Joubert & Prinsloo, 2009). For instance, most schools are characterized by a lack of resources, inadequate practical skills and a lack of content knowledge and methodologies. In other instances, educators feel that problems such as a lack of facilities like classrooms and a teacher-ratio which is too high, demoralize them and result in a lack of discipline in schools (Mudau, 2014).

Through experience and observation, the researchers have observed that school management teams have different experiences of education in Senior High Schools. These manifest themselves in various ways. The school management teams as well as teachers in various districts often express their dissatisfaction with the way in which they are expected to manage curriculum changes in Senior High Schools. They complain about a lack of proper consultation on the part of the Ministry of Education represented by the Curriculum Research and Development Division.

Furthermore, the introduction of ICT and other learning areas in the Curriculum results in a challenging situation for schools. The reality is that there are very few facilities to meet the demands brought about by the curriculum change. In addition, inadequate resources, together with a lack of practical skills, content knowledge and the right blend of pedagogical content knowledge have made the management of curriculum change more difficult in Senior high schools in Ghana. The school management teams in these schools have a difficult path to tread in terms of dealing with the implications of how to make the management of curriculum change a reality. In an evaluation of the gains with the introduction of the new curriculum it seems that conditions are still the same in most of the secondary schools in Ghana as they were prior to the start of democracy.

Due to problems such as inadequate training regarding curriculum implementation, lack of guidelines for managing and monitoring the implementation of curriculum changes and the complexity of managing new changes in the existing curriculum, most secondary schools in Ghana are not able to successfully manage curriculum changes. Educational institutions, like all other organizations, require constant monitoring to identify areas for potential improvement. This is necessitated by the fact that commercial enterprises, non-profit organizations, service industries, government instrumentalities and educational institutions all undergo change (Apple, 2004).

The quest for a school curriculum that best addresses Ghana's development agenda has been at the core of the country's policy making efforts. Indeed it can even be argued that the state had realized the centrality of such curriculum soon after independence by establishing several committees for the designing and developing school curricula. As pointed out by Kelly (2009), Ghana's curricula reforms have passed through phases reflecting the dominant philosophy and education policies at that period.

The curriculum changes and reforms that have taken place so far in Ghana were purposely conducted to address elitist tendencies that dominated the post-independence and colonial-adopted curriculum, to provide education for more of the rural majority, to make schools more self-reliant, to encourage attitudes favourable to agricultural work, to contribute to a reduction in urban drift, and to help integrate the schools with the community (Blignaut, 2011). The changes on school curricula that were introduced after the mid-1980s were a reaction to the adoption of liberal policies at the macro-level, after which the various social and economic sectors had to abide with. Education began to be looked as a commodity to be bought and students became the client. Syllabuses that for so many years were provided to schools at no cost by the Government began to be sold in bookshops as well as by the responsible institute. Textbooks, another freely-provided item became a huge commodity in the market with global publishing conglomerates competing for it.

The focus of this write up is to investigate the curriculum changes that need to be managed in the Ghanaian context to enable us create a contextualized emergent model for curriculum change management derived from experience and educational policies. This enabled us situate the model in the wider global context of research, theory and practice by establishing its implications on Ghanaian Universities.

Curriculum Change Management

Curriculum consists of intentionally undertaken activities that are planned so that certain objectives will be reached, so that learners will come to know certain things and have habits and patterns of emotional response (Skillbeck, 1996). In other words, *curriculum* is that which is taught at school. It is an approach that focuses on and connects teaching in a school, giving meaning to what teachers do and making teaching predictable.

Change is defined as a phenomenon that affects all aspects of a person's life (Mampuru, 2001) represents the struggle between what is and what is desired. *Change* may be described as the adoption of an innovation, where the ultimate goal is to improve outcomes through an alteration of practices (Print, 2013). In the context of education, *change* means that the school principals are exposed to new controls and regulations, growth, technological developments and changes in the workforce (Kotter & Schlesinger, 1999). *Change* has both technical and human aspects. It begins and ends with individuals acting in unison to make schools effective. In short, *change* refers to a planned, systematic process affected by individuals, and which takes time to come to fruition.

Curriculum change management therefore refers to a process whereby human resources are utilized to provide the successful implementation of an innovation of what is to be done at school with the aim of fulfilling the particular teaching and learning needs and achieving the stated goals of the school (Apple, 2004).

Curriculum and Curriculum Reform

According to the earliest work on curriculum by John Franklin Bobbit, curriculum originated from the chariot tracks of ancient Greece and later the Latin term *currere* (to run) adopted to represent it (Kelly, 2009). The term 'curriculum' used within the higher education context can mean different things to different groups (Barnett and Coate, 2005; Fraser and Bosanquet, 2006). Sometimes the curriculum is reduced to the structure and content within one course. In this paper, the description of course and program that is made by Biggs and Tang (2011) is retained. So the focus is on aspects of curriculum development that go beyond those of course design and include all courses within one program. Curriculum theorists of the 20th Century went further to include the entire scope of formative deeds and experiences taking place within school and without, the planned and unplanned experiences as well as those that were intentioned done and carried out (Kelly, 2009). In his work (the Long Revolution), Raymond Williams points out that the content of a curriculum helps to guide distribution of education in society as the cultural choices involved in the selection existed in organic relationship with the social choices. Greek and Latin philosophical thinking later greatly impacted on Western school curricula systems. As noted by Apple (2004), curriculum is the foundation of any education system, and thus it often requires frequent revisiting for improvement of prescribed standards and to reduce inconsistencies.

Mitigating Factors Influencing Curriculum Change

Due to the worldwide dynamics for change on account of technological developments, the curriculum of a school is subjected to considerable pressure to change from its current situation. Within the Ghanaian context this demand is extremely prominent in order to enable the country's citizens to cope with the changing socio-political, economic and technological environments within the context of a 'new' democracy.

Technological Environment

Technological changes have serious consequences for changing the curriculum since they result in major changes in the kind of knowledge that society wants its youth to acquire.

Technological changes lead to changes in the values and norms of society and thus put tremendous pressure on the curriculum (Shiundu & Omulando, 2012). These changes bear testimony to the fact that the technological platform on which products and services are built is growing in complexity. Work processes are re-organized and new knowledge is constantly introduced. Different skills and management competencies from those required in the previous age of mass production are therefore required. These new competencies include proficiency in Mathematics, computing, reading, writing and reasoning, the ability to use resources and information constructively, the ability to understand systems and master technology as well as flexibility to cope with change in the workplace (Pretorius, 2001). The fact that Ghana is now part of the global economy means that businesses have to adapt to the structural changes required. All these changes require continuous evaluation to ensure that the curricula and content of subjects offered in schools are indeed suitable and equip learners to face the challenges in the workplace. These challenges relate to an increased demand for science, engineering and technology-orientated skills, of which the demand for knowledge and skills in the use of computers and calculators is but one example (Horn, 2006).

Socio-Political Environment

Curriculum change in schools reflects changes in society at large (Print, 2013). Such changes are invariably indirect in nature and the association or linkage between societal and curriculum change is rarely a perfect match. Many societal changes may have a significant impact upon the school curriculum in several ways. For instance, the culture of a locality plays a critical role in the teaching and learning process of the Ghanaian curriculum.

Economic Environment

The successful adaptation of workers to the country's structural change was also slowed down by several economic factors such as high levels of unemployment, inflation, interest rates, taxes which has indirectly led to the denial of access to quality education to the vast majority of the population for many years (Marishane, 2002). These economic changes have had significant change on the country's educational system (Shiundu & Omulando, 2012). These changes influenced the curriculum to change in order to provide sufficient skilled manpower to meet the demands of the local and the global society. In Ghana, many changes in the curriculum have come about due to the politically inclined demand for equity linked to the economically inclined demand for competency at the world market. For instance, on a very broad scale one could consider how the school curriculum in Ghana has changed to reflect the general economic changes in society since independence. These changes have exerted greater demands for basic competencies and a greater vocational orientation. Furthermore, the increase in the importance of knowledge-based skills to adhere to a service sector economy has led to smaller demands for unskilled labour. In Ghana, greater emphasis needs to be placed on technical and occupational education, particularly at the secondary and higher educational levels. These changes were viewed as a progress towards a golden age (Blenkin, Edwards & Kelly, 1992). More recent developments have put an increasingly higher demand on the cultivating of skills to be productive in a knowledge-based economy.

Curriculum Change and Development Models

Curriculum models help curriculum designers to systematically and transparently map out the rationale for the use of particular teaching, learning and assessment approaches. Ornstein and Hunkins (1993) suggest that although curriculum development models are technically useful, they often overlook the human aspect such as the personal attitudes, feelings and values involved in curriculum making. Therefore, they are not a recipe and should not be a substitute for using your professional and personal judgement on what is a good approach to enhancing student learning.

As commonly described, maybe slightly simplistic version, of polarized curriculum models are those referred to by many authors as the 'Product Model' and the 'Process Model'. describes the emphasis of the former on plans and intentions and the latter on activities and effects (The Process Model). The Product Model can be traced to the writings of Tyler (1949) who greatly influenced curriculum development in America (O'Neill, 2010):

Models that developed out of Tyler's work, were criticised for their over emphasis on learning objectives and were viewed as employing very technical, means-to-end reasoning. The higher education context in Europe, which has been strongly influenced by the 1999 Bologna Declaration (European Commission, 2009), uses a model not dissimilar to Tyler's work. (O'Neill, 2010, p. 63).

The Product Model, however, has been valuable in developing and communicating transparent outcomes to the student population and has moved emphasis away from lists of content. Recent literature in this area suggests that in using this model, care should be taken not to be overly prescriptive when writing learning outcomes (Apple, 2004). For example, Hussey and Smith maintain that:

accepting that student motivation is an essential element in learning, we propose that those who teach should begin to reclaim learning outcomes and begin to frame them more broadly and flexibly, to allow for demonstrations and expressions of appreciation, enjoyment and even pleasure, in the full knowledge that such outcomes pose problems for assessment. (Hussey & Smith, 2003, p367).

Knight (2001) expresses the advantages of a more Process Model of curriculum planning in comparison to the Product. He notes it makes sense to plan a curriculum in this intuitive way, reassured by the claim from complexity theory that what matters is getting the ingredients - the processes, messages and conditions - right and trusting that good outcomes will follow. This suggests that when working in a more Product Model of learning outcomes, it may be more valuable to first consider what it is you are really trying to achieve in your teaching/learning activities and to then write your programme and/or module learning outcomes.

In addition to the Process and Product Model, there are a range of different, more specific, models that individually or collectively could suit your programme design. Some of the curriculum models have grown out of different educational contexts, such as Senior High School, Higher and Adult Education. However, many are transferable across the different areas. Some are described as 'models' and as they become more specific they may be referred to 'designs', i.e. subject-centred designs.

Strategies and Models of Curriculum Change Management

The curriculum as it is conceptualized in this paper is not a static description. On the contrary, it is a dynamic environment that cannot be grasped within one snapshot. It develops continuously due to environmental demands and contextual changes. Therefore, to make the conceptual scheme useful in different contexts (e.g. designing, revision, experiencing) and for different stakeholders (teachers, students, policy makers, alumni,...) the curriculum is approached from different points of view.

Development of curriculum understanding

A first perspective taken into account was the vision of the curriculum as a place to develop understanding. Kelly (2009, p.91) argues that outcomes of a curriculum should be defined in terms of intellectual development and cognitive functioning rather than in terms of quantities of knowledge absorbed or in terms of behavioural changes. He emphasizes the consequences for curriculum planning (Kelly 2009, p.94): (1) rejection of the knowledge base for curriculum planning, (2) clear statements of the underlying educational principles or processes, and (3) education as a process of development. Discussing the curriculum in higher education should be about discussing the students' learning experience as is emphasized by other authors (Posner, 1995). By incorporating the process of intellectual development student learning becomes prevalent.

Product and process approach to curriculum

A second perspective is the focus on a process approach additional to the product approach. The product approach is initiated by Tyler's (1949) rather mechanistic conceptualization of planning quality curricula by posing four questions: (1) What is to be accomplished? (2) What learning experiences will help accomplish the purposes? (3) How can these learning experiences be effectively organized? (4) How can the effectiveness of the learning be evaluated?

Stenhouse (1975) advocated for a process approach. He proposed to select content, develop teaching strategies, sequence learning experiences, and assess students' strengths and weaknesses with an emphasis on empiricism: a process curriculum was designed to be not an outline to be followed but a proposal to be tested. Knight (2001) also argues for a process approach by stressing the necessity of coherence and progression in a curriculum. He returns to Jerome Bruner's concept of the spiral curriculum (Bruner, 1960), saying" Bruner depicted a good curriculum as a spiral of repeated engagements to improve and deepen skills, concepts, attitudes and values, and extend their reach. The spiral curriculum has coherence, progression and, I claim, value" (Knight 2001, 371).

Planned, delivered, experienced curriculum

The final perspective is recognition of the difference between the planned, delivered and experienced curriculum (Prideaux, 2003). What is planned by staff members for the students may differ from what is delivered and from what students experience or actually learn (Posner, 1995). Therefore, a continuous process of aligning planned outcomes with the delivered program and its confrontation with the experience of graduated students and alumni is necessary. This approach also serves to uncover both the hidden curriculum (unconsciously transmitted and received messages by instructors and students) and the null curriculum (what is not taught) (Eisner, 1979).

Curriculum Change Process

Many educational change processes are technically simple but socially complex. In this regard Dean (2005) points to the fact that personal and social changes within schools are complex and, on occasions, contradictory and confusing. Some of this confusion is the result of staff members actively embracing a

rigidly bureaucratic approach which serves their interest, rather than the needs of their clients. In this regard, Van der Merwe (2002) is of the opinion that the implicit assumption of a curriculum led approach, in which the teacher and the learner are one and the same, has to be questioned, and the learner given a separate identity and a greater degree of autonomy.

Against this background, the process of curriculum change management should provide the means by which high quality learning is achieved. In Ghana, the process of curriculum change after independence found teachers ill-prepared for the new demands placed on them. Teachers were exposed to embryonic changes resulting from the vision of a national curriculum designed to provide direction for changes across the country (Jansen, 1998). Curriculum change in Ghana became the pious wish for changes in the social system at large. In order to understand these socio-political and economic changes foreseen to be brought about by curriculum change in Ghana, one should be able to understand the process of curriculum change which includes a number of aspects namely, need, mobilization, implementation and institutionalization (Blignaut, 2011).

Needs Identification

The beginning of the curriculum change process lies in the expressions of concern, dissatisfaction or need with the current curriculum or curriculum practices (Dean, 2005). Consequently, a demand or expressed need may come from a variety of sources such as teachers, learners, parents, administrators, employers, educational systems or a combination of these sources. Change will not occur without this need being present. At times persuasive methods to promote change are necessary if curriculum change is to succeed. People must recognize and accept the need for curriculum change (Print, 2013). If classroom teachers, for instance, do not recognize and accept the need for a particular curriculum innovation they will become resistant to it and hence place the success of the curriculum change in jeopardy. Thus, the first phase of successful curriculum change may involve those initiating the changes to convince change participants of its value.

Mobilization

Mobilization is the process whereby the system prepares for a change in state (Blignaut,

2011). *Mobilization* can be described in terms of four functions, namely, policy image development, planning, internal and external support. Delivery of the essential material needed for effective implementation was often uneven and often the essential documents were confined in the principal's office (Jansen, 1998). External and internal support was often missing from the mobilization phase of micro-implementation (Blignaut, 2011). The teaching and learning support services in many provinces were not established and, in those provinces, where it existed, officials were not appointed or lacked the necessary capacity to offer the necessary support. Principals were also not supportive of radically transforming the curriculum because this threatened the status quo.

Implementation

The implementation phase may be considered as a continuum, stretching from the need of a new curriculum until its complete acceptance (Print, 2013). In the curriculum change process, implementation begins with the initial attempts by teachers to effect the innovation into various schools/institutions. As this phase progresses, participants usually develop confidence and expertise and so it has a greater chance of success. This is a crucial phase in the change process.

Institutionalization

For the innovation to have been institutionalized required that innovation is used continually over time (Print, 2013). This phase has to take time and change cannot be considered to have occurred successfully until institutionalization is evident. Many innovations appeared to succeed in the earlier stages only to flounder when exposed to the broader context for which they were intended. Many innovations in the curriculum received the artificial support in the form of finance, consultants and administrative favour during the early stages of implementation. The removal of these supportive factors led to the demise of the innovation. By contrast, schools that were lacking support and which were essentially destabilized by high staff turnover, inadequate leadership support, low levels of resources, poor support services and constant student mobility had difficulty institutionalizing change (Print, 2013).

The Role of School Management in Managing Curriculum Change

The school management team has the day-to-day responsibility for the professional and operational management of the school. This means making sure that the policies agreed on by the school governing body are put into practice, that all areas in the school function effectively and that people work productively towards achieving the school's vision and mission (Blignaut, 2011). With regard to change, much of the school's activities revolve around the school management team. This determines to a great extent, the school's success or failure when change is implemented (Blignaut, 2011). In order to effectively manage curriculum change, the school management team should take into account both the degree to which the total school community will be affected by the curriculum change and the degree to which the school community is aware of the changes. As a result, the school management team should play an active role in managing curriculum change.

A school management team functions effectively if the senior managers (principals and deputy principals) and the middle managers (heads of department and senior teachers) work together (Van der Merwe, 2002). Apart from possessing detailed knowledge of the realities of teaching and learning the senior managers should offer clarity of purpose and vision in order to help the school management team to act with authority (Van der Merwe, 2002). Ofsted (2014) indicates that the higher order cultural and symbolic role of the school management team pertains to ensuring an adequate foundation of experience and knowledge with the opportunities for discussion, reflection and evaluation, in order to give learners the maximum scope to develop the spiritual, moral, social and cultural dimensions of human life. The key role of the school management team is to encourage members of staff to reflect upon, debate and agree on collective interpretations of how the curriculum should be taught and the range of experiences which

learners should be offered. However, the reality indicates that a lack of time and resources are the constraints that hamper school management teams to take on more than routine administrative tasks (Blignaut, 2011). This effectively hampers the process of teaching and learning.

Managing the School Environment for an Effective Curriculum Change

The school has different levels of accountability at school management and classroom management level. This accountability relates to ensuring that quality teaching and learning happen within the school (Marishane, 2002). It is the responsibility of the school management teams to ensure that their schools deliver their brief against the mission, vision, curriculum goals and action plans for their schools. With regard to the demand for curriculum change, the success of a school lies in its success in creating a supportive environment for curriculum change to take place. There are a number of indicators that can be put in place to measure this success. The main indicator relates to increased learner performance and attainment. A second important indicator relates to defining ways of motivating teachers and learners to accept challenges presented to them by the new practice (Marishane, 2002). Related to this is the identifying and developing of support strategies and mechanisms and the defining of teaching and learning expectations. This means that the outcomes for teaching and learning practices should be clearly spelt out.

Pedagogical leadership as a network of curriculum development processes

A very high number of the doctoral theses assessed the pedagogical leadership from several different perspectives, but none has comprehensively linked pedagogical leadership to school management. The researcher who has perhaps proceeded farthest in this respect is Print (2013), whose synthesis finishes up presenting a basic education principal as being a broad pedagogical leader. In addition to planning and organizing teaching work, Print suggests that a principal as a broad pedagogical leader also attends to the qualitative development of knowledge and learning. Print includes knowledge management under pedagogical leadership and expands pedagogical leadership into a need and concept relating to the entire organization.

Building on the doctoral thesis by Apple (2004), among others, it is probably possible to expand Print's view even further also to cover other organizations besides schools. Apple's doctoral thesis is a case study on superiors as team tutors and pedagogical leaders in a process organization. The study was carried out in a company and reversely utilises educational research and terminology concerning pedagogical leadership. Apple (2004, p.72) defines pedagogical leadership as being 'the superior's ability to guide subordinates towards the common goal, make the specified visions and objectives visible and teach people to understand and interpret, as well as discuss and manage interaction by means of positive interdependence and openness'. It is probably fair to say that the role of every organization's leader nowadays is to be the organization's pedagogical leader responsible for development and management of organizational knowledge, staff's professional development, utilization of distributed leadership, development of a creative learning culture and management of network based learning. The new broad pedagogical leadership seems to be formed in a network of interaction and development processes used by the superior to influence and develop staff's attitudes, behaviours and actions. A principal's broad pedagogical leadership covers both direct and indirect pedagogical leadership while also being interactive. The key aspect in a principal's direct pedagogical leadership is the principal's direct guidance and support for teachers' knowledge and learning both as part of everyday school operations and by means such as development discussions. A principal's indirect pedagogical leadership refers to the way in which the principal leads the school's key development processes, which indirectly guide and support knowledge and learning both among teachers and within the entire school organization. A principal's pedagogical leadership needs to be interactive so as to allow resources at different school levels to participate in pedagogical leadership as appropriately as possible. In this case, members of the school organization will form a community of learners, where the principal is a learner along with everyone else.

At an educational institution, it is possible to distinguish four key development processes:

- i. curriculum development;
- ii. development of the organizational culture;
- iii. creation of vision objectives and agreeing on strategies; and
- iv. specification of the basic mission.

It is essential to carry out the four above-mentioned functions as development processes rather than individual events and measures. It is also key to ensure that the development processes form an integrated whole. Furthermore, it is important to understand that development processes need to be led. It is precisely the leadership required by development processes that makes them key practical pedagogical leadership tools and channels of influence for a principal. It is important to recognize the fact that curriculum planning, implementation, evaluation and improvement process lies in the core of the principal's pedagogical leadership. The curriculum is the end result of this curriculum development work and provides a guideline for the school. The curriculum planning, implementation, evaluation and improvement process is work that requires broad interaction which involves both the need and the opportunity for the principal to exercise significant influence and leadership vis-à-vis teachers. As part of curriculum development, it is necessary to examine teaching staff's competencies, development needs and knowledge management. The curriculum development process highlights the roles of both teachers and the principal as learners and developing individuals. It is, therefore, possible to consider that the objective of internal school development is to create a community of learners (Print, 2013).

Management of the curriculum development process lies in the core of a principal's pedagogical leadership. If the principal does not lead the process, it will be led by someone else, which means that the principal gives up perhaps their most important pedagogical leadership tool. Since management of the curriculum development process cannot solely be technical management, it is also fair to say that a school principal needs to be a solid pedagogue with teaching qualifications. Being a professional manager is not enough on its own for successful school management.

Elements for the conceptual framework

As a first step in the process of developing the framework, the literature describing curriculum change and design within higher education was searched and reviewed. The resulting frameworks (Davis

2011; Diamond, 2008; Herring & Bryan, 2001; Hubball & Burt, 2004; Morcke & Eika, 2009; Prideaux, 2007; Stark & Lattuca, 1997) were analysed and we identified the following characteristics.

- Based on scientific literature concerning (adult) learning theories, curriculum development, academic or educational development, instructional design;
- Clarifying both the distinction and relation between curriculum development as a whole and design of individual courses;
- Generic in its description of the curriculum so that it is usable for every discipline within higher education;
- Be useful in the design, revision and evaluation of a curriculum;
- Giving opportunities to every stakeholder (teaching staff, students, managers, representatives of the discipline and labour market,...) to discuss the curriculum from his own point of view;
- Easy to introduce via a short presentation, a metaphor or a clear schematic representation.

It was also observed that all frameworks met at least some of the characteristics and were taken to the next step in the analysis. Because of the impact of accreditation on curriculum change and development, the quality critera used in several accreditation schemes were also included (Stensaker & Harvey, 2006).



Conceptual Framework for Curriculum Change Management for Higher Education

Source: Researchers' own construct 2018

We compared all components of the different frameworks. Similar components were aggregated into meaningful clusters, which were discussed until consensus was reached about their content and meaning. Our review revealed the following eleven elements for curriculum change and development. These are factors to be considered to ensure a meaningful curriculum change process.

- The educational philosophy: the description of the educational purposes and instructional philosophy that underlie curriculum decisions, reflecting the vision and mission of the institution e.g. which learning theories underpin teaching and learning (Diamond, 2008; Stark & Lattuca, 1997; Morcke & Eika 2009).
- The positioning of the curriculum: encompasses the level (Undergraduate, Bachelor, Master,...etc.), orientation (strategic choices about content) (Diamond, 2008) and the strategic choices about the disciplines involved compared to similar curricula at other institutes. For this element ample description was found in literature, but our own experience and context told us that introducing the 'level' actually helps stakeholders to discuss if their proposed program is most suitable to result in a Bachelor, Master or other degree. Moreover, positioning its own curriculum against similar curricula regarding the disciplinary content enables to substantiate the choices made by the program.
- The learning outcomes at the program level: selection and integration of the knowledge, skills, and attitudes to be acquired by the graduates (Diamond 2008; Stark & Lattuca 1997). In accreditation schemes curricular outcomes are mentioned in terms of results judged against targets' (Stensaker & Harvey, 2006).
- Structure and sequence: all courses are sequenced and structured together to form a coherent program of study (Stark & Lattuca, 1997; Stensaker & Harvey, 2006) with specific attention to vertical and horizontal integration (Hubball & Burt, 2004).
- Learning, teaching and assessment strategies should be tuned to the educational philosophy, should enable students to obtain the learning outcomes and should be aligned between courses (Stark & Lattuca, 1997; Stensaker & Harvey, 2006).
- The discipline, the research community, the labor market (with alumni) and the society are all closely related to and influencing curriculum choices. It's important to take into account e.g. the needs of employers and recruiters, the expectations of society, new findings of the research communities, the accreditation requirements and those of the disciplinary associations (Diamond, 2008; Stark & Lattuca, 1997).
- **Institutional resources** include facilities for teaching, organisational infrastructure and technology, quality and quantity of teaching staff, their experience and expertise, staff/student ratio and financial resources (Diamond, 2008; Stark & Lattuca, 1997; Stensaker & Harvey, 2006).
- Policy includes departmental, institutional, regional, (inter)national regulation, organization and legislation (Stark & Lattuca, 1997; Oliver et al., 2008).
- Student characteristics that need to be considered are student selection, characteristics of incoming students, diverse background of students (previous knowledge, experience or degrees, ethnic diversity,...) (Diamond, 2008; Stark & Lattuca, 1997; Stensaker & Harvey, 2006).
- Resources for students include student guidance, student mobility and facilities for students/learning (Stensaker & Harvey, 2006).
- The individual courses that together form the program of study (Prosser & Trigwell, 1999, Biggs, 1999, Ramsden, 2003, Biggs & Tang, 2011, Elen, 2002).

Implication of the Framework to Educational Theory and Practice Framework Description in Brief

The educational philosophy, the positioning of the curriculum and the learning outcomes constitute the 'planned curriculum', represented by a triangular box in the scheme. The three meta-concepts within are in close relationship to each other. The educational philosophy describes which learning theories underpin the choices in teaching and learning strategies to help student reach the learning outcomes. The learning outcomes are determined by the positioning or the scope that is chosen for the curriculum. The main box stands for 'the aligned curriculum'. The conceptual scheme for course design (Elen, 2002) is placed in the middle of this box and is visualised in different layers, indicating that all courses are sequenced, structure and sequence and aligned learning, teaching and assessment strategies. They represent the most visible part (for every stakeholder) of a curriculum, the so-called program of study. Moreover, the arrow between the main box and the triangle box indicates the 'planned curriculum' which is guiding how individual courses are designed and how the different courses are structured and sequenced and aligned to each other. These two boxes (top triangle box and main central box) are 'owned' by the department or the group of teachers that deliver the curriculum, meaning that they take decisions about the (re)design process. All these stakeholders are influencing (and influenced by) the choices that departments make in defining their position/profile, learning outcomes and educational philosophy. Besides the main box in the center, all organizational or managerial elements are represented that influence the way courses are designed, sequenced or aligned: institutional resources, policy, student characteristics and resources for students. These components have to be taken into account by departments and program leaders in their curriculum decision-making.

Main Implication of Framework

We came out with five core elements for quality change and development of curricula To cope with the complexity of working on curriculum related issues, five core elements of quality curricula change and development are proposed, which are intricately interconnected. Going through all components connected by a circle enables their alignment. Changing one of the components will influence the other connected components. Going through the circles also means taking into account the perspectives and agenda of different stakeholders and searching for the best answer or compromise. This focus on change was partly inspired by the 'paths' described by Stark and Lattuca (1997), illustrating how evaluation and adjustment operate in their curriculum model. These are the core elements.

1. The quality circle of the planned curriculum: By confronting the elements of the planned curriculum to the expectations of the influencing stakeholders, both new and renewed curricula can be planned or the plans can be evaluated. To plan or adjust a curriculum it is necessary to find out what the expectations from the labor market and society are for graduates in the discipline. Also the input from the associated research communities - being on top of the state-of-the-art knowledge - is essential. To position a program within the educational market it is necessary to compare the planned outcomes with equal or similar programs within the institute

and abroad. The educational philosophy should be attuned to recent research on learning and teaching.

- 2. The implementation of a curriculum: This core element makes the link between the planned curriculum and the aligned curriculum. It investigates the way the intentions are realized. In an empiric way, the planned curriculum can be seen as a proposal that can be tested by gathering evidence on students' learning experiences (Stenhouse, 1975). Alumni can be asked if and in what way the planned learning outcomes were realized in the curriculum. In a similar way, faculty teaching in the Master program can appreciate the level of incoming graduated Bachelors. This circle focuses on the curriculum as a process (Stenhouse, 1975). It is about how students experience the sequencing in the learning process and assess the (learning) strengths and weaknesses of the program of study. A curriculum map is a useful tool to demonstrate the link among learning outcomes and their realization in courses or course modules, learning opportunities and assessment. Curriculum maps allow identifying actual or potential deficiencies in the curriculum through consultation of different stakeholders.
- 3. The aligned curriculum: The aligned curriculum consists of all courses of the curriculum which are ordered in a certain sequence (in function of content and capacity building, in years or semesters or phases of time) and are structured in core courses (obligatory), in optional modules or as elective courses. This reflects a progressive curriculum (Knight 2001). Skills and attitudes need to be acquired through different courses with an ever increasing complexity. In a coherent curriculum learning trajectories indicate how students transfer learning and deepen their understanding going from one course to the next. Alignment between courses is necessary to balance teaching, learning and assessment strategies in such a way that the intended learning outcomes can be realized (Litzinger et al. 2011).
- 4. **The aligned course:** This quality circle is reflected in the scheme for instructional design, which was first described by Elen (2002). As he mentioned it "is a general concept that promotes if-then reasoning's" focusing the instructional design process on the constructive alignment (Biggs 1999, Fink 2003) of the different components of a course (learning objectives, learning activities, student characteristics, evaluation strategies, the learning environment and context). In an effective educational setting, these components are coherently and consistently implemented and aligned to each other.
- 5. Actors acting on the curriculum: Although, the scheme itself does not focus on the actors involved, several stakeholders are connected to the curriculum and integrated in the scheme: researchers, alumni, employers and the society are represented on top of the scheme. These stakeholders will be consulted on their ideas, experiences and needs when the planned curriculum is discussed by teachers and students. On the other hand alumni will, when employed, further explore innovations developed by research which they studied during the curriculum, in this way enhancing the society. Furthermore, students, faculty, teaching assistants engage in learning experiences throughout the aligned curriculum. They draw upon these experiences to rethink and optimize the planned curriculum (Oliver et al. 2008, O'Neill 2010). In this process of

optimization, the role of the students is crucial: as they are the key actors in experiencing the program, their feedback on the different components and their relations is essential. Furthermore, program leaders and policy makers on all levels (departmental, institutional, regional, national, international) influence the planned as well as the aligned curriculum. They envision the contextual factors influencing the curriculum, manage the curriculum and plan and coordinate quality development initiatives.

Conclusions

In order to understand the social, political and economic changes to be accommodated within the Ghanaian society, the process of curriculum change is relevant. The curriculum change process includes the phases of need, mobilization, implementation and institutionalization. The need phase for curriculum change manifests in expressions of concern or dissatisfaction with the current curriculum and curriculum practices, which may come from a variety of sources such as teachers, learners, parents, administrators, employers, educational systems or a combination of them. It is, therefore, to reiterate that the school management team has the responsibility of managing the implementation of curriculum change on account of societal demands forthcoming from the political and socio-economic terrains. To be able to succeed in this, school management teams should know what the major roles are that they need to play to ensure that curriculum change is implemented. From the empirical investigation it became clear that school management team participants are sufficiently knowledgeable on what their roles and responsibilities, pertaining to curriculum change management, are. Considering the major hampering effects of successful curriculum change management, namely inadequate classrooms and teaching facilities and a need for the continuous training of staff, school management teams, as the responsible and accountable facilitators of the implementation of curriculum change, should be sensitized to a gradual proactive addressing of the persistent problems. This could contribute to a slow but steady increase of contextualized success with the management of the implementation of curriculum change.

Future Directions

In order to improve the role of the school management teams in managing curriculum changes at the second cycle institution level, the following recommendations are made.

- 1. The Ministry of Education should find ways to provide schools with sufficient classrooms and teachers to ensure that school management teams are in a position to properly manage the implementation of the changed curriculum successfully.
- 2. School management teams, in collaboration with school governing bodies, should steer vigorous fundraising attempts in aid of an adequate financial position, to enable schools to purchase the required additional teaching and learning resources needed for self-discovering activities to ensure a successful change of the curriculum for quality education delivery.
- 3. The Ministry of Education should adequately provide schools with the basic teaching and learning resources needed for quality education delivery in order for school management teams to manage the implementation of curriculum change successfully.

4. The Ministry of Education in conjunction with the Ghana Education Service should ensure that the practice of curriculum change is highly decentralized to reflect local concerns. Thus, the decentralization of the process would be tailored towards the local needs of the area. This would make education more meaningful and relevant to students.

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FINANCIAL INCLUSION AND ECONOMIC GROWTH OF NIGERIA (*THE MICROFINANCE OPTION*)

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Abstract

The main focus of this study is to establish the relationship between financial inclusion and economic growth with particular reference of microfinance for the period 1992 to 2013. Using Ordinary Least Square method and employing the Johansen Cointegration tests the study revealed that the activities of microfinance as one of the financial inclusion strategy significantly contribute to economic growth. While total loans and advances of microfinance banks significantly contribute to economic growth, total deposits inversely affect economic growth. The study also reveals the presence of long-run relationship between the variables considered (GDP, total loans and advances, total deposits, investments and number of microfinance banks) The study reveals that the growth and development of a nation is significantly dependent on the expansion of banking and financial services to the currently financially-excluded class of citizens of the country, as they possess untapped and unexplored valuable potentials that will be of tremendous to the country. In view of the benefits inherent in financial inclusion, this study recommends that microfinance banks should concentrate efforts on low cost deposits which are in line with their operations than competing with the conventional banks in mobilizing fixed deposits that has higher cost attached to it. Financial education is also recommended to enlighten the public on benefits of a financial superstructure.

Keywords: Economic Growth, Financial Exclusion, Financial Inclusion and Financial Superstructure

Introduction

In order to enhance the flow of financial services to Nigeria's rural areas, government has, in the past, initiated a series of publicly financed micro and rural credit schemes and policies targeted at the poor. Notable among such schemes were the rural banking programme, sectoral allocation of credit, a concessionary interest rate, and the agricultural credit guarantee funds scheme. Other institutional arrangements were the establishment of the Nigerian Agricultural and Co-operative Bank Ltd (NACB), the National Directorate of Employment (NDE). The Nigerian Agricultural Insurance Corporation (NAIC), the People's Bank of Nigeria (PBN), the Community Banks (CBs), and the Family Economic Advancement Programme (FEAP)

In December 2005, the Central bank of Nigeria (CBN) introduced a microfinance policy framework to enhance the access of micro-entrepreneurs and low income households to financial services required to expand and modernized their operations in order to contribute to rapid economic growth. The policy complements the banking sector reforms, not only brings the microfinance activities under the regulatory purview of the Central Bank of Nigeria (CBN) but also aims at providing sustainable access to financial service by the economically active poor. At the same time, it is targeted at creating an environment of financial inclusion to boost capacity of Micro, Small and Medium Enterprises (MSMEs) to contribute to economic growth and development.

In this policy framework, the CBN acknowledge that;

• Robust economic growth cannot be achieved without putting in place a well-focused programme to reduce poverty through empowering the people by increasing their access to factors of production, especially credit.

• Microfinance services are about providing financial services to the poor who are traditionally not served by the conventional financial institutions.

The formal financial system provides services to only about 35% of the economically active population before the advent of microfinance banking while the remaining 65% were excluded from access to financial services. This 65% was being served by the informal financial sector through the non-governmental organisation (NGOs) – microfinance institutions, money lenders, friends, relatives, credit union and financial cooperatives. The non-regulation of activities of these institutions has serious implication for CBN's ability to exercise on aspect of its statutory mandate of promoting monetary stability and sound financial system.

Economic growth is an objective of financial inclusion which includes political, economic and social inclusion (Nalini et al, 2012). Enhancing financial innovation and Access (EFIA, 2013) defines financial inclusion as the provision of a broad range of high quality financial product such as savings, credit insurance, payment and pensions which are relevant appropriate and affordable for the entire adult population, especially the low-income segment of the economy. It could also be said to be the delivery of financial services at affordable costs to the unbanked and low-income segments of the society. It is the opposite of financial exclusion where those services are neither available nor affordable to a certain category of economic agents, particularly the low income members of the society (Umaru, 2014).

Financial inclusion is intended to connect people with banks for consequential benefits (Mariappan, 2012). This allows the formal financial system to play its original role (financial intermediation) of promoting economic growth which is a major difficulty of most developing countries like Nigeria.

The ability of the active poor to access, easy, affordable and safe financial services is a pre-condition for accelerating inclusive growth because poverty is usually synonymous with financial exclusion, people are left with the option of patronizing the informal finance providers which in most cases, are expensive, not organized and full of doubts (Sequn . et al 2014).

Research Problem

In Nigeria, there are many reasons for the high rate of the unbanked and those lacking of access to financial services, especially among the rural dwellers. These include, lack of infrastructural development, illiteracy, poverty and insecurity. The result of EFInA access to financial services in Nigeria in 2012 survey showed that about 349 millions adults representing 39.7% of the adult populations were financially excluded. This means that only 28.6 million adults were banked, representing 32.5% of the adult's population (EFInA, 2013).

Over the years, financial inclusion of rural dwellers and active poor suffers the needed attention from the financial institutions in Nigeria. Rural financial intermediation and small business financing are conspicuously missing on the priority of the conventional banks. As a result, the rural sector and the active poor remained heavily constrained by its small economic capacity due to inadequate financial consideration. Yet, the rural sector and active poor with its characteristic small business has the potential for capacity building and economic drive in any economy. Therefore, failure to recognize this as a challenge would amount to undermining the roles of the sector in economic growth. Do the activities of microfinance banks really encourage financial inclusion and in the long-run affect economic growth? Financial inclusion is critical to the attainment of sustainable economic growth in Nigeria; therefore, the objective of this study is to establish the link between microfinance, its inclusion and possible contribution(s) to economic growth in Nigeria

Objective of the study

The main objective of this study is to determine linkage or relationship between microfinance and financial inclusion as well as microfinance and economic growth. Other specific objectives are to;

- i. determine the relationship between microfinance banks' total deposit and economic growth
- ii. determine the relationship between microfinance banks' total loans and advance and economic growth
- iii. establish the link between the number of bank branches and economic growth of Nigeria.
- iv. investigate the effect of banks' investment on economic growth of Nigeria.

Although microfinance is often seen as a tool to improve financial markets, there seems be lack in studies relating to microfinance to financial inclusion and economic growth. As such, the fundamental questions that this study aims to answer are;

- i. How does microfinance promote financial inclusion and economic growth?
- ii. What is the relationship between microfinance banks' total deposit and economic growth?
- iii. What is the relationship between microfinance banks' total loans and advance and economic growth?
- iv. What is the link between the number of bank branches and economic growth of Nigeria?
- v. Do bank investments effect economic growth?

In order to achieve the above stated objectives, these research hypotheses were formulated:

- i. H₀₁[:] Loans and advances to financially disadvantaged do not positive impact on economic growth of Nigeria
- ii. H₀₂: There is no significant relationship between microfinance total deposits and economic growth of Nigeria
- iii. H₀₃: There is no significant relationship between the number of bank branches and economic growth of Nigeria.
- iv. H₀₄: there is no significant relationship between bank investments and economic growth.

Synopsis of Related Literature

Conceptual Review.

Financial inclusion refers to the timely delivery of financial services to the disadvantaged and low income group at an affordable cost (Serrao et al, 2013). It includes availability of, and access to, different types of formal financial services at reasonable prices. Financial inclusion is the benchmark used to assess how formal financial services reach the common people in the economy (Uma et al., 2013). It is a term commonly used to represent the deliberate attempt which makes the poor, marginalized people and those vulnerable to low economic power to engage in formal economic process through ownership and usage of formal financial service at regular intervals.

Financial inclusion is the enabling access to financial resources and service for different economic agents at an affordable cost, especially to those with lower income (Mbutor and Uba, 2013). It could also be said to be the delivery of financial services at affordable costs to the unbanked and low-income segments of society. It is the opposite of financial exclusion where those services are neither available nor affordable to a certain category of economic agents, particularly the low income members of the society (Umaru, 2014). According to Nalini and Mariappan (2012), financial inclusion is intended to connect people with banks for consequential benefits. This allows the formal financial systems to play its original role of promoting economic growth which is a major difficulty of most developing countries.

Economic growth is an objective of financial inclusion which includes political, economic and social inclusion The exclusion of any person or group of people from these three dimensions of inclusion will lead to financial exclusion because the political, economic and social life of people are interwoven and the three dimensions are required to attain financial inclusion. Where majority are excluded from the financial system, the gain of economic development does not reach every one and this leads to inequality. Hence, inclusive growth is needed in an economy in order to share the benefits of economic growth more or less equally among all sections of people (Uma et al., 2013) which may be a mirage where majority are not part of the financial system

Fig 1:

Analytical Framework to Microfinance and Financial Inclusion

Financially Excluded (Poor and Low Income Households)



Financial Markets and Intermediaries

Source: Jovec et al (2011)

The diagram above suggests how microfinance is seen as the poor and low income households' link or bridge towards financial inclusion. Through the financial services provided by microfinance such as savings, access to credit and insurance, more people become included in the financial system – both by definition and in actuality.

Financial institution influences not only the efficiency or resources allocation throughout the economy but also the comparative economic opportunities in individuals from relatively rich or poor households. Financial institutions exist to serve as intermediaries in a market with high information asymmetries and transaction and information costs. As the bridges between the firms and households, financial institutions live up to the primary function of being able to spur growth and development. Though this may be the case, there exists a divide within the financial system in itself. As it is at present, a considerable number of people are excluded in financial system. Financially excluded, as they are defined to be, there is a seen need for them to be included in the financial sector.

The World Bank usually measures the level of financial inclusion through certain banking measures. These include number of bank branches, number of accounts, and the domestic credit as percentage of GPD and domestic deposit as a percentage of GDP. These indicators for financial inclusion however, as Sarma (2008) argues are not enough because it may identify one dimension of banking outreach.

The practice of microfinance in Nigeria during this period was culturally rooted and dates back several centuries. The traditional microfinance institutions provided access to credit for the rural and urban low-income earners. They are mainly of the informal self-help groups or rotating savings and credit association

types. Other providers of microfinance services include savings collectors and co-operative societies. The informal financial institutions generally have limited outreach due primarily to the paucity of loanable funds.

Financial inclusion is the provision of the right incentives to individuals which help to overcome barriers that are central to stability and growth, poverty reduction and equitable distribution of resources and capabilities (Serrao et al., 2013). Financial inclusion is imperative for economic growth process because, as more people are brought into the formal financial system, it will help in proper planning and decisionmaking with more reliable data. It also assists in reducing the volume of money outside the banking sector. This is useful for monetary policy decisions by the government and its agencies such as the central bank. The effectiveness of monetary policy would be improved by growing financial inclusion (Mbutor and Uba, 2013).

In order to integrate more people into the formal financial system, due consideration should be given to some issues. Law and order is a vital requirement for the establishment of more banks in many locations (Aube and Laidlaw, 2010). If banks cannot be established in rural areas, the bank officers can travel to such locations at regular intervals. However, the security of the bank officers and the cash becomes an issue of concern in a country like Nigeria. Can the government guarantee law and order to pave the way for financial inclusion, especially in remote locations? The Boko Haram issue in Nigeria is a major challenge for financial inclusion in such locations where present.

Barriers to Financial Inclusion

The EFInA Access to Financial Services in Nigeria 2010 Survey groups the barriers to financial inclusion into the following three categories:

Demand-side barriers occasioned by various reasons, such as irregular income, lack of employment and low literacy levels.

Supply-side barriers brought about by long distance to access points, too high cost of services and inappropriate products.

Regulatory barriers such as cumbersome KYC requirements, lack of trust in the financial service provider and high rate of corruption.

Strategies for Achieving the Financial Inclusion Targets

In pursuing the stated targets, efforts was concentrated on the following strategic areas:

Agent Banking: Agent banking is the delivery of banking services outside traditional bank branches, through additional touch points such as existing retail stores and petrol stations or via technology such as Point of Sale' (P05) devices and mobile phones.

Mobile banking/Mobile Payments: Access to financial services through mobile phones that are intermediary either directly linked to a bank account or use of mobile wallets as virtual money accounts.

- Linkage Models: Enhancement of financial and business cooperation between conventional financial institutions (deposit money banks and development finance institutions) / government and microfinance banks/institutions for wholesale funding and on- lending transaction.

- **Client Empowerment**: Increase of bankability of population through coordinated national financial literacy initiatives that are complemented by consumer protection.

Empirical Review

Access to financial inclusion is the ability to use available financial (services from formal finance providers which depends on the conditions for the opening and using of a bank account (Serrao et al, 2013) such as location of banks to the people and the charges paid to the bank for operating a bank account.

The findings of Uma at al. (2013) provide dear support for the above, especially that it took a fortnight for 87% of their respondents to have their accounts function after the submission of the completed bank account opening application forms. It was found that 80% visited their banks just once in a month while 50% kept their money at home rather than the bank. Access to formal financial services or financial inclusion in developing economies is critical to economic growth and reduction in inequality among citizens of a nation. Financial power that is derived where access to finance is possible could create a partition between the rich and the poor, the educated and the illiterate, and urban and rural dwellers because those with formal financial access have unlimited access to enhance their financial power with varied, options from the formal finance providers.

Serrao et al. (2013) asserted that the Jack of access to finance is a critical mechanism for the persistent income inequality, as well as slower growth which influences resource allocation and the comparative economic opportunities of individuals in the economy. Access to formal finance creates an opportunity for people to increase their income and productivity through purchase and sale of goods and services with the possibility of reduction in poverty and improvement in standard of living.

Usage in financial inclusion represents the regularity, duration and frequency of use of financial services over time (Serrao et al., 2013) which also includes the combination of services used by individuals. Increase in number of bank branches may not necessarily lead to improvement in financial inclusion, especially if those new branches are located where other banks already exist. But if bank branches are located where there are no existing banks, financial inclusion will increase as new accounts are opened for those that are hitherto unbanked. With this, financial inclusion in Nigeria may be a mirage because, according to

Mbutor and Uba (2013), an absolute number of bank branches do not necessarily imply increasing financial inclusion, because the practice of stationing many bank branches in a small geographical location is common to banks, and the resultant effect of this practice is customer poaching rather than financial inclusion. For example, although the cashless policy of the CBN is in place in Ogun State, a place like

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Obafemi Owode, the headquarters of Obafemi Owode Local Government Area has no commercial bank, likewise some other local government headquarters in Nigeria. Their findings that the number of bank branches as a measure of financial inclusion did not come out with the right sign. It seems also that the recent sale of some banks like the former Intercontinental Bank Plc reduces financial inclusion, because some of the branches of the bank were closed by the buyer. This might have forced some people out of the fanatical system because such people probably did not have what it takes to patronize div nearest banks, especially if the closed bank branch was the only bank in the area. The CBN should have given incentives to ensure the continuous existence of such branches for the purpose of accelerating financial inclusion for economic growth.

A major constraint to the participation and contribution of the poor to economic growth is limited access to formal savings (Aube and Laidlaw, 2010). A study by Nalini and Mariappan (2012) reveals the challenges of financial inclusion as improper repayment of loan facility, need for additional employees by the banks, consumption of more time, difficulty in canvassing, high cost requirement, heavy work-load and low consumer awareness. Nigeria is a cash based economy as a result of different businesses in the informal sector. The epileptic supply of electricity also contributes to this, likewise the illiteracy level in rural areas and some parts of the urban centres. Unreliable infrastructural facilities made financial inclusion difficult and costly (Aube and Laidlaw, 2010).

Dashi et al. (2013) reported that the lack of a suitable range of products and services and the limited institutional capacity of financial service providers are the major bathers to financial inclusion. The possible financial products for financial inclusion are savings accounts, current accounts, mobile banking, rural banking and electronic banking. Mobile banking may appeal more to the educated but the regular breakdown in mobile telecommunication network poses a challenge that may make people to be reluctant in subscribing to the service. Mobile banking or M-banking is used to describe financial services delivered via mobile networks using mobile phones. The services provided include depositing, withdrawing, sending and saving money, as well as making payments. M-banking is also referred to mobile financial services (MFS). A mobile payment is a point-of-sale payment made through a mobile device that can be a mobile phone or personal digital assistant. Mobile money, on the other hand, refers to a service that allows users to transact and store electronic value on a dedicated account associated with a mobile phone number, redeemable for cash (Umaru, 2014).

As more robust technology solutions and telecommunications infrastructure come into the market, banks will increase account openings, payment services and savings mobilization from clients through mobile channels. Already, 14% of African adults access payment services on their phones; usage is at its highest in East Africa, with 35% of adults (Brian, 2014). It should be noted that M-banking does not make any meaning to the illiterate, especially those without access to government electricity supply.

Again, the study of Segun et al (2014) which look at the economy of financial inclusion in Nigeria, found out a high access to bank services.

This work seeks to determine the linkage between microfinance, financial inclusion and economic growth for the period 1991 to 2013. Using Ordinary Least Square method and employing the Johansen Cointegration, we will be able to find out at the end of this work whether microfinance through financial inclusion targets contribute to economic growth in Nigeria.

Methods and Materials

This study adopted data for analysis to cover the period, 1992 - 2013, and were sourced from CBN Statistical Bulletin, the CBN Annual Report and statement of accounts for the relevant years.

Because we are interested in finding out whether a relationship exist between microfinance, financial inclusion and economic growth, we employed the Johansen Cointegration and Ordinary Least Square (OLS) test

The dependent variable, which forms the major basis for the study is economic growth is proxied by GDP (Gross Domestics Product).

Model Estimation

Following a detailed review of previous studies and theoretical evidence of (Jovec, at al 2011), the theoretical equation which explains the linear relationship between financial inclusion of microfinance and economic growth is specified thus:

```
GDP = F (TDM, TLA, NBB, INV.)..... Eqn (1)
This functional relationship can be transformed econometrically to;
GDP
              \alpha_0 + \alpha_1 \text{ TDM} + \alpha_2 \text{ TLA} + \alpha_3 \text{ NBB} + \alpha_4 \text{ INV} + u....\text{Eqn} (2)
         =
Where;
GDP
                   Gross Domestic Product
              =
TDM
              =
                   Total Deposits Mobilized
TLA
                       Total Loans and Advances
              =
NBB
                    = Number of Bank Branches
INV
                          Investments
                 =
              Constant
\alpha_0
                  Coefficients
              =
\alpha_1 - \alpha_4
              Error Term
         =
u
```

Apriori expectation are $\alpha_1 > 0$, $\alpha_2 > 0$, $\alpha_3 > 0$, $\alpha_4 > 0$

By the rule of thumb and assuming every other thing remains equal/constant, since Nigerian financial sector is going through a lot transformation and low level of financial education, it is expected that microfinance total loans and advances, total deposits and the number of microfinance as financial inclusion strategy positively contributes to economic growth.

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By opening accounts and mobilizing deposits many initially excluded poor and active individuals will be included thereby increasing the funds required to be extended to micro and scale entrepreneurs. Again, total loans and advances granted by microfinance banks to micro and scale entrepreneurs also contribute to economic growth. Also, it is expected that the higher the number and spread of microfinance banks in any system, the better it stands to reach out to many individuals thereby increasing the number of individual who accesses financial services

Data Presentation and Interpretation

Cointegration Test

Table 1 Result of Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.989913	157.6344	69.81889	0.0000
At most 1 *	0.788981	65.70428	47.85613	0.0005
At most 2 *	0.664665	34.58811	29.79707	0.0130
At most 3	0.431546	12.73562	12.49471	0.0249
At most 4	0.069419	1.438913	3.841466	0.2303

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

In table 1 above, the null hypothesis of no cointegrating vector can be rejected for all the variables used in the study and we accept the presence of long-run relationship between GDP, total loans and advances, total deposits, investment and number of microfinance bank.

Table 2: Ordinary Least Squares (OLS)

Dependent Variable: GDP Method: Least Squares Date: 11/02/15 Time: 17:34 Sample: 1992 2013 Included observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INV	0.118143	0.842771	0.140184	0.8902
NBB	7.612130	16.61154	0.458244	0.6526

TDM	-0.542445	0.406391	-1.334786	0.1995
TLA	1.461076	0.518718	2.816707	0.0119
С	-1242.556	11506.64	-0.107986	0.9153
R-squared	0.897849	Mean depe	ndent var	19894.86
Adjusted R-squared	0.873814	S.D. dependent var		24290.88
S.E. of regression	8628.776	Akaike info criterion		21.16031
Sum squared resid	1.27E+09	Schwarz cr	riterion	21.40827
Log likelihood	-227.7634	Hannan-Qu	uinn criter.	21.21872
F-statistic	37.35518	Durbin-Wa	atson stat	1.848329
Prob(F-statistic)	0.000000			

From the regression result in table 2 above, we have our estimated regression equation as: GDP = -1242.556 +0.118143INV +7.612130NBB --0.542445TDM +1.461076TLA

(0.140184) (0.458244) (-1.334786) (2.816707)

NB: the t-values are in parentheses

Global Statistical Results Analysis

The econometric property of the estimated equation shows that the global utility or the overall goodness of fit is high with an F- statistics of 37.35518. The Coefficient of Determination (R^2) of 0.89 or 89% implies that, at level series, about 89% of the total variations in the gross domestic products (GDP) are explained by the changes in the independent variables. The computed DW is 1.848 which shows that there is no presence autocorrelation

Variables	T-Statistic	Prob.Value	Observation	Decision
INV	0.140184	0.8902	p-value>0.05	Accept null
NBB	0.458244	0.6526	p-value>0.05	Accept null
TDM	-1.334786	0.1995	p-value> 0.05	Accept null
TLA	2.816707	0.0119	p-value < 0.05	Reject null

TESTS OF HYPOTHESES.

Source: Extracted fromEviews 7.0

This sub-section presents the result of hypothesis testing. Null hypothesis to be tested is that the explanatory variables (INV, NBB, TDM, TLA) used in the model have no significant relationship with economic growth of Nigeria. If the t-statistic of any explanatory variable is less than p-value at 5% significance, such variable is said to have significant impact on savings economic growth, and if otherwise it has no significant relationship.

As earlier observed, the F-statistic proved that variables entered have the capacity to determine the level of economic growth in Nigeria.

However, we will go on and test for individual contributions of each of these variables.

H01: Loans and advances to financially disadvantaged do not positive impact on economic growth of Nigeria .

Based on the table 2 above and the decision criteria, we reject the null hypothesis and accept the alternative hypothesis and conclude that Loans and advances to financially disadvantaged have positive impact on economic growth of Nigeria. This finding is in line CBN objectives for the establishment of Microfinance banks.

H₀₂: There is no significant relationship between microfinance total deposits and economic growth of Nigeria.

From the table 2 above, the p-value is greater 5%, we therefore accept the null hypothesis and reject the alternative hypothesis and conclude that there is no significant relationship between microfinance total deposits and economic growth of Nigeria

H₀₃: There is no significant relationship between the number of bank branches and economic growth of Nigeria.

Again, in line with decision rule, we accept the null hypothesis and reject the alternative hypothesis and conclude that there is no significant relationship between the number of bank branches and economic growth of Nigeria.

H₀₄: There is no significant relationship between bank investments and economic growth.

Based on the decision rule, we accept the null hypothesis and reject the alternative hypothesis and conclude that there is no significant relationship between bank investments and economic growth

The result above implies that there is a positive and significant relationship between economic growth and microfinance total loans and advances (TLA). The total number of microfinance branches (NBB) and total investment (INV) have positive though insignificant relationship with economic growth. Again, a negative influence of TDM to economic growth was established although the relationship is insignificant. The implication is that a unit increases in TDM decreases the GDP by 0.542445 units. This is against our aprori expectation and can be attributed to the high interest payment on the deposit mobilized. This means that microfinance mobilized fund (especially fixed deposit) at higher rate and probably find it very difficult to get customers to borrow at that high rate.

Conclusion

This research work examined the linkage between microfinance, financial inclusion and economic growth of Nigeria. The study revealed that the activities of microfinance as one of the financial inclusion strategy significantly contribute to economic growth. From the analysis above, (table 2) while total loans and advances of microfinance banks significantly contribute to economic growth, total deposit inversely affect

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economic growth. This account for the largely deposit mobilized through fixed deposit which has higher interest charges than the prevailing lending rate. Furthermore, the number of microfinance bank as financial inclusion strategy has no significant impact to economic growth. This is in line with the findings of Mbutor and Uba (2013).

The growth and development of a nation is significantly dependent on the expansion of banking and financial services to the currently financially-excluded class of citizens of the country, as they possess untapped and unexplored valuable potentials that will be of tremendous to the country.

Policy Recommendations

In view of the benefits inherent in financial inclusion, this study recommends:

- 1. That microfinance banks should concentrate efforts on low cost deposits which are in line with their operations than competing with the conventional banks in mobilizing fixed deposits that has high cost attached to it.
- 2. The regulatory authorities should encourage the establishment of microfinance banks in the rural areas to reach the unbanked population.
- 3. Government should also provide enabling environment and the needed security that will ensure the long term growth and efficient performance of the bank. Financial education is also recommended to enlighten the public on benefits of a financial superstructure.
- 4. Finally, high quality financial products which are relevant, appropriate and affordable for the entire adult population, especially the low-income active poor should be designed and timely and seamless make available.

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THE LIFESTYLE OF FEMALE HEAD PORTERS: THE SINGLE MOTHER AND HER COPING STRATEGIES AT ABOABO, KUMASI

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ABSTRACT

This study sought to find out the lifestyle of female single mothers head porters and their coping strategies at Aboabo, in the Kumasi Metropolis. The study aimed to find out the causes of migration, the health, social and institutional challenges that face these vulnerable female single mothers as they seek to meet their daily needs. The research design used for this study was quantitative survey strategy and explanatory. Purposive sampling (judgement/selective/subjective) was used to select the study sample size of one hundred (110) respondents. The data collection instruments were questionnaires. The study findings revealed that: the rainfall pattern in the Northern part of Ghana was unstable and makes most single mothers to migrate to Kumasi to work as head porters. Moreover, some of the health problems face by the head porters included; malaria, typhoid, and anaemia and other diseases due to poor shelter and sanitation. The plight of these vulnerable women would be improved if non-governmental organizations were invited, encouraged and supported them by providing affordable dormitory accommodation for them and alternative jobs.

Keywords: Female Migrants, Single Mothers, Health, Jobs, institutions

1.0 Background of the Study

Given to the indiscriminate economic challenges of the Ghanaian milieu coupled with the natural need to strive for a reputable placement in the societal caste system, people will always try their best to make ends meet through the engagement of available decent jobs (Appiah-Yeboah, 2009). However, the term 'Decent', even though relative, is far from being associated with the Ghanaian head porterage business due to its somewhat ubiquitous plight it faces. With a lackluster attitude to reach a cashless / credit-based economy juxtaposition the over-emphasis on its cash equivalent which comes with its economic challenges, there has been excessive pressure on people especially breadwinners to look for a well-paying job or more than one job in order to earn a substantive income to meet the basic needs of life (Appiah-Yeboah, 2009). Female head porters in Ghana, often migrate from the northern parts of the country to urban cities in the south to look for job opportunities or well-remunerated jobs with the hope of raising enough capital to

invest in less labor-intensive ventures since they lack these opportunities in their place of origin (schandorf, 2008).

As a result of the lack of resources in certain region of Ghana, people are compelled to leave their family and friends and move to a different location as a way to make ends meet (Appiah-Yeboah, 2009). That is in search of job opportunities which are non-existent and to manumit themselves from the destitute north (their place of origin), some inhabitants of the north (mostly females) move to the south in pursuit of their economic dreams which mostly land them in the head porterage business (schandorf, 2008).

It must be noted that, migration from the north to the southern part of Ghana is not a recent phenomenon. According to Nabila (1985) cited in Kwankye, (2011) and Lobnibe (2010), migration from the northern part of Ghana to the middle and southern belts began quite early since the colonial authority was actively involved in attracting labour from the northern savannah agro-ecological zone. The tradition of kayayei is so common, even expected, that the only statistics are a handful of rough estimates from aid organizations. Some place, their numbers as high as the tens of thousands, and many Ghanaians maintain that yearly every northern woman will travel south at some point in her life (DiCampo, 2009).

Single mothers from rural areas, particularly the northern regions move to markets in urban centers to serve as kayayei, female porters, who carry goods on their heads for a negotiated fee. Away from support from their home communities and families, most end up living and working under very poor conditions and are exposed to both physical and reproductive health risks, Awumbila and Ardayfio-Schandorf (2008). It must however be quickly accentuated that, the porterage industry is not only made up of female northerners of Ghana but also, their male counterparts also engage themselves in the porterage business just that, it is prevalent amongst the females. In their line of work, whereas some are mobile, others are stationary, mostly at stores who are combat ready to carry goods purchased by buyers. There are myriad of reasons why they engage themselves in the porterage business of which the dominant one being the quest for money (Awumbila and Ardayfio-Schandorf, 2008). Other peripheral reasons may include the displacement of homes due to tribal wars, fleeing from betrothal marriages, the edge to settle in the developed south.

It is true that, the youth constitute the true wealth and future of our country and thus, addressing their hopes and aspirations must be an integral part of our socio-economic development efforts. Successive government have over the years, realized the need for policies that would empower the youth for effective participation in the national development agenda, however, their approach has not achieved their set objective as kayayo incident is still on ascendency (National Youth Policy, 2010).

1.1 Statement of the Problem

It is unarguably true that, kayayeis are fraught with poor living standards such as inability to access or afford: quality healthcare, three or two square meals a day or balanced diet, decent clothing and decent shelter. All these basic needs are interlinked such that inability to afford three or two-square meals a day or a balanced diet makes them (both mothers and children) malnourished, inability to afford decent shelter makes them prone to diseases such as malaria, pneumonia etc. of which they stand a high risk of dying since they cannot afford quality healthcare when their sicknesses get worse. Lack of proper shelter also makes them externally vulnerable to cases such as rape, teenage pregnancies and high risk of contracting

STIs. It is no surprise that, teenage kayayeis as early as 12 to 13 years do have babies and mostly do not have partners or lack committed partners / fathers to take care of them and their babies. Such kids are sometimes as a result of rape. Since some of the kayayeis are breadwinners from their place of origin, they are under intense pressure to overwork to meet up with the demands of the family. Since the human body responds to stress, constant overwork leads to physical breakdown and since they lack the ability to access quality healthcare, it could lead to their demise.

The study was therefore conducted to help attenuate the high level of single mother kayayei and to offer them other alternative of living by linking them up with appropriate agencies such as National Youth Employment Agency (NYEA), Ghana Youth Employment and Entrepreneurial Agency (GYEEDA), Savannah Acceleration Development Authority (SADA) who are bent on implementing policies to curb some of these social cankers. Since most of them are illiterate, they have no idea about the policies put in place and the result of this study is also intended to help improve their standard of living by outlining other alternative source of livelihoods based on result driven or tailor-made recommendations.

1.2 Leading Research Questions

- What factors causes female porters to migrate from their destinations to the Kumasi Metropolis (Aboabo)?
- What health problems face these single mothers?
- Which social problems do the kayayei face?
- What problems do the kayayei face in their business?
- What challenges are posed by the Kumasi Metropolitan Assembly to their daily activities?

1.3 The Objectives of the Study

General objective:

The general objective of the study was to evaluate the lifestyle of a single mother female head porter and her coping strategies in Aboabo - Kumasi.

Specific Objectives:

To achieve the above objective, the researchers specifically intended to:

- Establish the causes of migration of the female porters from their place of origin.
- Examine the health challenges they (kayayei) face.
- Examine the social challenges they (kayayei) face.
- Identify institutional challenges they (kayayei) face in trying to meet their ends.
- Assess the coping strategies of the female head porter (single mothers)

1.4 Research Justification

As a social intervention of the new government to improve upon life in Zongo communities (i.e. a slum residence mostly concentrated with indigents and somewhat a hub for the kayayeis), it has introduced the Zongo Development Fund with a seed capital of USD 50,000,000 to help ameliorate the plight of such residents which there is the likelihood of the creation of improved shelters in such communities. There is

also an abolishment of the popular 'kayayei taxes' which has been greeted with immense applause. It is likely that, all these interventions would change the status quo of the kayaye is and researchers may have to review, conduct, assess and assume new assertions because the situation may not be the same now. This then provides justification as to why it is prudent for this research to be undertaken.

2.0 LITERATURE REVIEW

This section mainly explored some eminent theories and relevant studies in this area of study. Accordingly, the literature review offered a thorough look at the theoretical framework, historical background of head porterage reviewed, socio-demographic profile of head potters reviewed, review of some relevant studies, conceptual framework and summary of work done.

2.1 Theories/Models/ Perspectives

According to Comte (the father of sociology), research in the sciences should always be guided by a theory so that the findings will either support or reject the theory. It was therefore necessary to dive deep with some sociological theories to see their viability and also in helping researchers of this study explore the lifestyle of female head porters and their coping strategies.

This study therefore applied the assumptions of five (5) theories/models, namely: The Push and Pull Theory of Migration, The Survival Strategy Approach and Household Strategy Approach, the Urban Bias Theory, The Harris-Todaro Model and The Theory of General Adaptation Syndrome (GAS) as a Coping Mechanism to Stress.

2.1.1 The Push and Pull Theory of Migration

Most studies on migration for example consider the "push and pull" theoretical framework developed by Lee in 1966 as one of the major theoretical underpinning for rural-urban migration especially for head porterage (Yeboah, 2008). The theory indicates that 'push' factors exist at the point of origin and act to trigger emigration. The push factors include, poverty, lack of adequate infrastructure in rural areas, parental neglect, breakdown of family structures, lack of education and employment opportunities, low family incomes, peer influence and debilitating socio-cultural

practices. On the other hand, the 'pull' factors' include the perceived availability of jobs at the destination, better infrastructure/social services and food and freedom from family pressure (Opare, 2003; Awumbila, 2007; Berg, 2007; Kwankye et al., 2007). This means that migration can only occur if the reason to emigrate (the push) is remedied by the corresponding pull factors at an attainable destination (Muñiz-Solari et al. 2010 cited in Solem et al. 2011). The theory however stipulates that the flow of migrants between two places may not totally develop if intervening opportunities exist between them; that is, the presence of other places between an origin and destination point to which one could migrate. Two issues emerged from the discussion of the causes of migration with the Lee's theory of migration:

1. That a combination of socioeconomic and political reasons influences people's decision to either emigrate (push factors) or in-migrate (pull factors); and

2. That the destination of the migrants is the shortest destination which has the socioeconomic and political answers the migrants seeks.

The intervening opportunity in the case of child migrants from Northern Ghana to the south could have been the Tamale metropolis or the Sunyani municipality. However, relative to the Kumasi metropolis which is the commercial hub of the northern sector of Ghana, the interventions from Tamale and Sunyani are not enough to prevent the child migrants from choosing Kumasi as their destination (Ghana Statistical Service, 2005). Thus, the Kumasi metropolis' endowment in social and economic infrastructure coupled with its proximity to the north relative to Accra, Sekondi-Takoradi and a host of other cities in the north makes it the first destination for migrants including the children.

In sum, the Lee's push and pull theory has affirmed the economic dimension of migration alluded to by the authors of this paper in the above. What is evident is that economic reasons are the major triggers of migration across the globe.

2.1.2 Urban Bias Theory

The Urban Bias Theory indicates that the concentration of economic opportunities (investments) results in the exodus of rural labour to the urban areas. This bias in favour of city has created a disparity between rural and city (in terms of consumption, wage and productivity levels), and thus translating into a higher standard of living by urban citizens which draws migrants from poorer (rural) areas. Juxtaposing this theory to the kayayei case, the head potters (kayayei) move from Ghana's 'deplorable north' to the 'rich and economically-vibrant south' in search of better future prospects; in this case Kumasi and Accra where socio-economic activities are vibrant. This theory is given credence by the Classical Economists who argue that rural inhabitants are attracted to the urban areas by high industrial wages which happens to be the premise of the Modernisation Theory.

3.0 RESEARCH METHODOLOGY

This section focuses on the procedures employed in collecting and analyzing the data for the study.

3.1 Research Design

This study employed the quantitative survey strategy using questionnaires among head porters (kayayei) located at Aboabo – Kumasi. This strategy was mainly used in tandem with other research strategies and approaches such as explanatory or exploratory research approaches. The survey strategy was used because it helps illicit information from a larger number of sample size which helps to generalize findings unlike qualitative research methods.

3.2 Population

The target population were female head porters (single mothers) in Aboabo in the Kumasi Metropolis. It was chosen because of time and the concentration of head potters in the area.

3.3 Source of Data

The data for the study were obtained from two main sources. These are primary and secondary sources. The primary data were obtained through questionnaires, direct observations and interviews. This helped to provide first-hand information and to minimize errors in the process of data collection. The secondary data sources were journals, articles textbooks, internet publications and other relevant and useful published materials.

3.4 Data Collection Instruments

Interview administered questionnaire was administered by researchers to collect the data. For the purpose of the study, structured questionnaire comprising 27 items (both open and closed-ended questions) was applied in this study.

3.5 Data Analysis

The researchers used descriptive statistics to make the analysis more meaningful. Data collected were presented in simple tables and cross tabulations, percentages and frequencies.

3.6 Study Area

Aboabo in the Asokore Mampong Municipal Assembly which is located within the Kumasi metropolitan area of the Ashanti region of Ghana, was the study area. The region is currently the second most urbanized in the country after Greater Accra (87.7%), the national capital. The housing stock in the region is 329,478, of which about 37% are in urban areas and 63% in rural areas (GSS, 2000). Due to its central location, all road networks linking the northern sector and the southern sector of Ghana pass through Kumasi, resulting in a high daily influx of traders and civil workers. Aboabo is about five to ten (5-10) Kilometers away from the center of Kumasi, the Ashanti regional capital. The Study area lies between latitude 7°38′04.6'' North and longitude 2°01′48.9'' West and presents a scenery of buildings, schools, and community center.

3.7 Sampling Techniques and Sampling Size

Convenience sampling was the non-probability sampling approach used, this sampling technique allowed the researcher to select respondents that were readily available at the time the study was being conducted. A total of one-hundred and ten (110) respondents were sampled to represent the entire population of female head porters (single mothers) in Aboabo in the Kumasi Metropolis.

The highest ethical consideration was observed in this study respondents' right to confidentiality, anonymity, and informed consent, and total disclosure on the part of the researchers, were ensured by the researchers.

3.9 Limitation of the Study

During the data collection process, the kayayeis indicated that, they had very limited spare times to spend on answering items on the questionnaire. Some could not make time to answer the questions considering their workload. As a result of this the data collection process spanned over a period of eight weeks instead of a four-week period postulated by researchers.

4.0 DATA ANALYSIS AND PRESENTATION

This section outlines the results of the study. It focuses on the presentation, interpretation and analysis of the responses of respondents sampled for the study.

4.1 Socio-Demographic Characteristics of Respondents

The age distribution of respondents showed that most of respondents sampled for the study were under the age of 18, which according to the laws of Ghana and the ILO law, depicts child labour. Thus, most people engaging in kayayei in the Kumasi municipality are said to be engaging in child labour. With the marital status of respondent's, it was not surprising that most of the kayayei that made up the study were single, as the literature indicates that most of the people engaging in kayayei were children below 18 years.

Significant number of the respondents were seen to have had no formal education (59.1%). Only three out of the 110 respondents had senior high education. The result pulled no surprise as kayayeis move away from home at a very young age which tend to affect their educational attainment. The resident of the respondents was also seen to be of important to the study as it will help to identify the living conditions of kayayeis. It was revealed that 71.8% of the respondents were lodging in wooden structures whiles 18.2% were in uncompleted building.

	Response	Frequency	Percentage
Age of respondents	Below 18 years	43	39.1
	21-25 years	6	5.5
	26-29 years	27	24.5
	30-35 years	19	17.3
	36-39 years	10	9.1
	40 and above	5	4.5
	Total	110	100
Educational level	No education	65	59.1
	Primary	27	24.5
	JHS	15	13.6
	SHS	3	2.7
	Total	110	100
Marital status	Married	5	4.5
	Single	70	63.6
	Widowed	25	22.5
	Divorced	10	9.1
	Total	110	100
Ethnic Group	Akan	2	1.8

 Table 1 Socio-Demographic Characteristics of Respondents

Ga-adamgbe	4	3.6
Guan	20	18.2
Ewe	7	6.4
Dagomba	77	70.0
Total	120	100

Source: Field Survey, 2017

4.2 Nature of activities

One of the objective of the study was to identify the kind of job activities engaged in by kayayeis. In achieving this objective, respondents were asked to indicate some of the activities they engage in, this section summarizes the nature of activities of kayayeis.

4.2.1 Nature of activity

When respondents were asked to indicate the difficult nature of their job, overwhelming, majority of the respondents, argued that the nature of the kayeyei activity is very tedious. Thus, 90% of the respondents asserted to that nature of their job was very difficult. Whiles only 10% of the respondents were of the notion that the nature of their job is easy and less tiring.

4.2.2 Nature of goods

With regards to the nature of goods carried by the kayayeis, it was found that majority of the respondents argued that the nature of goods carried was very heavy having a percentage of 81. Only eight out of the 110 respondents sampled concluded that they did not carry heavy goods. From all indication, we can conclude from the study that kayayeis tend to engage in jobs that possess high threat on their wellbeing.

Nature of goods	Frequency	Percentage %
Неаvy	89	81
Moderate	13	12
Light	8	7
Total	110	100

Table 2 Nature of goods

Source: Field Survey, 2017

4.2.3 Employing special skills in kayayei activity

Another result from the study was to look at whether kayayeis employ any special skills in their activity which tend to reduce the difficulty in their job. However, 96% of the respondents argued that they do not employ any skills in the kayayei activity. Looking at the findings, it was concluded that majority of the respondents do not employ any skills in the kayayei activity. Thus over 96% of the respondents, representing majority of the respondents asserted to that.

Figure 1 Employing special skills in kayayei activity



Source: Field Survey, 2017

4.2.4 Number of days worked in a week

Another approach in identifying the nature of activities of kayayeis was to find out the numbers of days they spend working in a week. From the findings, it was revealed that majority (82%) of respondents did not take a break from work throughout the week. According to them, they had to work every day if they want to earn money to survive. They were of the view that spending a single day at home could pose a threat on their living condition and that every day count. This revelation was found to pose serious health challenges on the respondents which would be discussed in the next section.

Figure 2 Number of days worked in a week



Source: Field Survey, 2017

4.3 Challenges they encountered in the kayeyei activity

The challenges kayayeis encountered in the nature of the work they engage in was seen to be of value to the study. This section provides a summary of some of the challenges they kayayeis go through.

4.3.1 Health Challenges

On the part of malaria, on few of the respondents concluded that malaria poses no threat on them, however, over 90% of the kayayeis that formed part of the study were of the view that malaria poses a significant

threat on their life as the nature of their job was quite difficult and also, also stay in a poor sanitation environment leading to malaria.

Another issue on the health challenges showed that typhoid fever was very rampant among the kayayeis with about 75% of them attesting to the fact that typhoid fever did cause serious health challenges among them. However, 25% of the respondents also disagreed to the assertion that typhoid is a health challenge encountered when engages in kayeyei business.

With regards to issue of cholera which has had lot of attention in Ghana in recent times was also accessed among the kayayeis, from their view, majority (95%) concluded that the incidence of cholera outbreak in Ghana is of no different from the their own. Thus, cholera seems to be a challenge faced by people engaged in kayayei. According to them, their job is in such way that they do not get time to practice personal hygiene which in effect, result in in health challenges.

As respondents indicated that they fall sick, they were further asked about how often they fall sick. From the data gathered, it was deduced that 40% of the respondents argued that they experience such illness every day; with a further 15% of the respondents also argued that they experience such illness on weekly basis. However, 30% out of the total percentage also asserted that they experience such illness on monthly basis, with a further 15% also arguing that they experience such illness yearly.

Stress which is mostly discussed by several literatures seen to have a significant effect on kayayeis as majority (85%) of the people that formed part of the study concluded that stress tend to be their most common challenge due to the nature of their job. Most of the respondents gave the notion that due to stress, they tend to experience headaches and back pain from carrying heavy goods to and from and for working all week.

When respondents were asked if they face any social challenges, it was revealed that out of the total percentage, 55% of the respondents argued that they do not face any social challenge with regards to their kayeyei business. On the flip side, 45% of the respondents argued that they do face social challenge with regards to their activity. Those who argued that they do face social challenge were of the view that at times they are been sacked by the KMA security guards, and in the long run, their pans that they used in carrying the loads are being seized.

4.3.2 What make head porters vulnerable to these illness

Aside getting to find out from the respondents the kind of diseases they encountered when engaged in kayeyei business. It was also the need to find out from the respondents what actually make them vulnerable to such illness. It was revealed that out of the total percentage, 30% of the respondents argued that sleeping outside makes them vulnerable to such illness, with a further 15% of the respondents also arguing that staying outside makes them vulnerable to such illness encountered when engaged in kayeyei business. However, 55% of the respondents argued that the carrying of loads make them vulnerable to such illness.



Figure 3 What make head Porters (Kayayei) Vulnerable to illness

Source: Field Survey, 2017

After identifying what causes kayayeis to fall sick, there was the need to find out where they seek treatment when they are sick. From the respondents, it was revealed that 20% of the respondents argued that they seek treatment from the hospital when they encounter any illness; with a further 5% also argued that they seek treatment from the herbalist. However, 35% of the respondents out of the total percentage also argued that pharmacy is the best place they consult when they want to seek treatment. 40% of the respondents also argued that they do self-medication when encountering any kind of illness, than to go to other places for medication.

4.3.3 Social challenge in the kayeyei business

Respondents that concluded that they did have social challenges were further asked if family expectation was a factor for engaging in kayayei activity, it was revealed 15% of the respondents disagreed to the assertion that family expectation back home is the reason why they venture into the kayeyei activity, However, majority of the respondents indeed argued that family expectation back home is the reason why they venture dinto the kayeyei business. Thus over 85% of the respondents asserted to that.

Marriage is very profound to the northern part of Ghana and due to the fact the most people engaged in Kayayei were from the northern Ghana, there was the need to find out from them whether it has an issue with their involvement in kayayei. Only 30% however indicated that pressure from the family to marry was a contributing factor for moving to Kumasi to engage in kayayei as a way to survive.

4.4 Effects of the kayeyei phenomenon on the kayeyeis themselves

After taking a look at the challenges encountered by the kayeyei people, it became necessary for the researchers to find out the effects of the kayeyei phenomenon on the kayeyei people themselves. Below sections are the effects, both positive and negative of the kayeyei phenomenon on the kayeyei people.

4.4.1 Positive effects

There is a perception among the outside world that, the involvement into the kayeyei business is to get money in order to acquire items for marriage, as such respondents were made to indicate if the activity was to earn them enough money marriage. Out of 110 respondents sampled, 15 % each said they are into this

activity in order to gather money for marriage whereas the other indicated the opposite. The 70% of respondents were unsure about their position on whether their activity was marriage purpose.

In view of getting to know from the respondents the positive effects they get when engaged in kayeyei business, it became necessary for the researchers to find out if indeed is because of the hardship situation in the country that is making them involve in the activity, so that in the long run they will be able to survive the hardship. it was deduced that out of the total percentage, about 55% of the total respondents engage in kayeyei as a way to support the hardship circumstances of their life, whereas only 10% of the respondents revealed that they did not engage in kayayei for the purpose of reducing the hardship burden.

In another instance, respondent were made to indicate if they engage in kayayei as a stepping stone to move into other ventures. From the data gathered, it was found that majority of respondents making a percentage of 65% had the notion that their motive was to gather money to engage in different business other than kayayei, whiles few of the respondents (8%) indicated that they had no intention of doing any other job. **Table 3 Positive Effect**

	Response	Frequency	Percentage
Money to acquire items for	not at all	17	15.5
marriage	a little	11	10
	moderate	38	34.5
	quite a bit	27	24.5
	extreme	17	15.5
	Total	110	100
To survive the hardship	not at all	11	10
	a little	3	2.7
	moderate	28	25.5
	quite a bit	7	6.3
	extreme	61	55.5
	Total	110	100
To make money to undertake	not at all	9	8.2
buying and selling for profit	a little	2	1.8
	moderate	28	25.5
	quite a bit	22	20
	extreme	49	45.5
	Total	110	100

Source: Field Survey, 2017

4.4.2 Negative Effects

After getting to know the positive effects of the kayeyei phenomenon on the kayeyei people, it became necessary for the researchers to depict the negative effects the phenomenon has on the kayeyei people. Respondents were asked to indicate if they engage in kayayei as a way to steal from others, it was revealed that out of the total percentage, 15% of the respondents argued that not at all do kayeyei phenomenon makes the kayeyei people involve in stealing, with a further 15% also arguing that its quite a little. However,

20% of the respondents asserted that it is moderate whiles others argued that sometimes kayeyei phenomenon leads to them involving into a stealing, with a further 20% arguing that it is extremely.

Respondents were made to indicate if kayayei results in physical defect, only 5% of the respondents were of the view that they had suffered physical effect from the work they do, where as 55% of the respondents concluded that there had not been any physical challenges on the work they do.

Cases of rape was also seen to be of vital to the study as most literature shows that rape cases are mostly recorded among kayayeis. However, when participants made to indicate whether there had been cases of rape incidence, 4% of the entire sample size concluded that there had not been any incidence of rape in their line of operation. The majority of respondents on the other hand gave the notion that the incidence of rape cases was very rampant in their area. This confirms reports of several literature on kayayei.

	Response	Frequency	Percentage
Involvement of kayeyi	not at all	17	16
in stealing	a little	16	15
	moderate	22	20
	quite a bit	33	30
	extreme	22	20
	Total	110	100
Suffered physical	not at all	61	55.5
defects	a little	27	24.5
	quite a bit	17	15.5
	extreme	5	4.5
	Total	110	100
Cases of rape issues	not at all	4	3.6
	a little	7	6.4
	moderate	22	20
	quite a bit	17	15.5
	extreme	60	54.5
	Total	110	100

 Table 4 Negative effect

Source: Field Survey, 2017

4.5 Coping strategies of female head porters

In the past, government and some Non-Governmental Organisations (NGOs) made attempts to empower Kayayei traders by engaging them in skills training or lifeline projects. The study wanted to find out from respondents if they are willing to change their line of work or willing to accept help to improve upon their situation.

Respondents were made to indicate what they think the government or the NGOs can help to support them. Respondents gave varying views and ideas they believe would help minimise the problem they go through. With some group of people given the view that having a place to stay and monthly allowance will enable them to learn a trade which after their training, will move back to their respective locality to help girls that have nothing doing and are also thinking of coming to the urban centres. Another group of people concluded that they are willing to do a different job such as cleaning or house girl as that job has less risk than being a kayayei. Also, it was indicated by the people that all what they need is money so a job that involves money will be fine by them. The responses giving was in line with some of the interventions given by respondents that however, could not achieve its target by the National youth employment program and the Bibir-Ghana (2009).

With a total of 110 respondents sampled for the study, it was found that majority of respondents are in search of a new form of venture than what they are presently in. Some were of the conviction that they are willing to get back in school to achieve their dream of becoming what they had hoped for. Surprisingly, 42.5 percent of the respondents were of the view that they are not in any way going to change their line of work as they prefer that to any other job available.

	Frequency	Percent
Yes	69	57.5
No	51	42.5
Total	120	100.0

Source: Field Survey, 2017

With 69 respondents that indicated that they are willing to either be in school or learn a trade, they were further asked to indicate the kind of training they would want to engage in or the school they intend to go. It was found that most of the respondents were willing to learn dress making and hair dressing as they indicated would fetch them enough money to take care of their kids and their parents. With respect to those who want to be in school, some indicated they are willing to go as far as class one whiles some indicated that they have completed junior high school and would want to enter into senior high education.

5.1 Recommendation

They should be encouraged to provide vocational training and counseling services to the young kayeyei by extending vocational services in schools for them. The suggestions by Agarwel et al, (1994) are supported here. The kayeyei should be involved in adult literacy programmes. As part of this programme they could undergo training in business management to enable them better to manage their business and finances. The education programme must include health education, especially on the cause, incidence and prevention of Sexually Transmitted Diseases and other health diseases.

5.2 Conclusion

With regards to demography of female head porters in Kumasi Aboabo, more of younger adult involve in kayeyei activity than older people. Education wise, it was concluded that majority of the female head porter had no educational background, with a few having their education at the basic level and junior high school level.

The findings of this study showed that some female porters were thriving despite the stressors they were exposed to. Some coping resources were identified as very important for thriving. The study further revealed that the majority of the head porters have contributed resources to rent single room apartments. The room occupancy rate of these single room apartments in the compound houses was five persons per room. Furthermore, few respondents slept in stores after close of work while some also lived in an abandoned.

The survey results depict that the common diseases suffered by the head porters were headaches malaria and body pains. They attributed these to the heavy loads they carry every day in order to cope with the economic demands of the cities. Other diseases such as typhoid, anemia, stress and skin rashes were reported by some of the head porters as health challenge.

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Effect of Computer Assisted Teaching Strategy on Students Achievement by Gender in Agricultural Education in Tharaka Nithi County, Kenya

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Abstract

Gender has remained relevant in education because it has been linked to achievement and participation in certain professions. Gender differences in achievement has been shown to vary according to school subject. This has partly been attributed to the teaching strategy adopted by the teacher. Computer Assisted Teaching (CAT) strategy is a method that uses computers in a learning media and strengthens student's motivation and educational processes. Little or no information is known about the impact of the strategy in teaching agriculture and consequently it's effect on achievement by gender. The purpose of the present study was to examine whether there is gender difference in achievement in agriculture among students exposed to CAT strategy. The study employed Solomon Four-Quasi-experimental design. The study was conducted in eight county secondary schools in Tharaka Nithi County, Kenya. Stratified random sampling technique was used in selecting sample schools. A sample of 327 Form One students participated in the study. The research instrument was Agriculture Achievement Test (AAT) with a reliability coefficient of 0.91. Descriptive statistics (means and percentages) and inferential statistic (ANOVA) were used for data analysis. The study showed that CAT strategy improved achievement in agriculture but male students performed better than female students after exposure to CAT strategy. The study concluded that CAT is an effective strategy in improving achievement in agriculture and therefore agriculture teachers should incorporate CAT strategy in their teaching.

Key Words: Achievement, Agriculture subject, Computer Assisted Teaching, Gender

Introduction

Agriculture is a subject that is offered as an optional subject at the secondary school level in Kenya (KIE, 2006; Vandenbosch, 2006). The aim of teaching agriculture in secondary schools is to ensure that learners are exposed to basic principles necessary for agricultural production in the country. Teaching of agriculture is expected to promote the acquisition of skills for self reliance in agriculture (Mwiria, 2002). Agriculture as a subject in secondary schools plays several core educational and economic roles which are geared towards improvement of human welfare (Vandenbosch, 2006).

Despite the importance of agriculture, students' performance at KCSE has remained below average with gender differences in favour of boys (KNEC, 2014). The average mean score for the years 2010, 2011,

2012, 2013 were 38%, 41% 38% and 34% respectively (KNEC, 2014). Research has shown that one of the factors affecting students' achievement is the teaching strategy adopted by the teacher (Barchok, 2011; Ngesa, 2002), thus one of the possible reasons for the under achievement could be the teaching strategy employed by the teacher agriculture teacher.

Even with such students' dismal performance in agriculture, female students have had lower achievement as compared to male students in national examinations in Kenya. The male score for male students for the years 2011, 2012, 2013 were 39.31, 37.24 and 35.59 respectively. The mean score for female students over the same period were 34.26, 32.02 and 31.07 respectively. This implies that in agriculture male students perform better than females. If gender differences exist in general performance of boys and girls, then teaching strategies that minimizes this gender gap should be sought. Research has shown that the teaching strategy adopted by a teacher affects achievement in agriculture with respect to gender of the student (Kibett, 2002; Ngesa, 2002).

Taking into account that agriculture is the backbone of Kenya's economy, effective teaching strategies should be adopted in teaching the subject. The commonly used teaching and learning approaches in agriculture are teacher centred (Loveless & Ellis, 2002). Most agriculture teachers use lecture and discussion methods (Ngesa, 2006). These methods are teacher-centred where learning is highly teacher directed and students have little input during the teaching learning process (Ryder, Burton & Silber, 2006). There has been a paradigm shift and teaching methods are changing with the tendency of being learner-centred with less focus on the teachers (Lang, Arthur & Herbert, 1995). In the modern modern teaching learning environment, the learner is the main focus and is responsible for his knowledge. Information communication technology tools like computers are being incorporated in classroom teaching as an attempt to make learning more learner-centred, with less focus on the teachers. Computer assisted teaching strategy makes learners actively search for knowledge with the aid of computers. Computers are used as a medium of instruction to facilitate learning.

Studies have shown that a teaching strategy adopted by the teacher affects achievement with respect to gender of the student. A study by Ngesa (2002) on the impact of experiential and mastery learning programme on academic achievement in secondary school agriculture indicated that boys scored significantly higher than girls under both experiential and mastery learning programme. In another study it was shown that performance of boys in cognitive skills and practical skills was significantly higher than for girls after exposure to projects (Kibett, 2002).

Studies have been done to investigate gender differences in performance when students are taught by use of computers. A study Gambari, Falode and Adegbeno (2014) investigated the effectiveness of computer animation and geometrical instruction model on mathematics achievement and retention among junior secondary school students. Results indicated no significant difference in the mean achievement scores for males and their female counterparts when both groups were taught geometry using computer simulations.

Studies done in Kenya indicate similar findings. In another study, (Kiboss, Ndirangu & Wekesa, 2004) found that computer mediated program improved the learners outcome in cell biology. In the same study, findings showed no relationship between the learners' gender and their learning outcomes. The present study was designed to determine whether there was gender difference in achievement in agriculture among students exposed to CAT strategy.

Purpose of the Study

The purpose of the study was to investigate the effect of CAT strategy on students' achievement by gender in agriculture in secondary schools in Tharaka Nithi County, Kenya.

Objective of the Study

To examine whether there is gender difference in achievement in agriculture among students exposed to CAT strategy.

Hypothesis of the Study

The following null hypothesis guided the study.

H₀1: There is no statistically significant gender difference in achievement in agriculture among students exposed to CAT strategy.

Methods and Materials

Research Design

The study employed quasi-experimental research design and in particular Solomon Four Group design. Quasi-experimental design uses natural assembled groups such as classes in research. The design allows the researcher to randomly select a sample from the population without the random assignment of individual cases to comparison groups. Quasi-experimental design was found appropriate for the present study because the research participants (students) were not randomly assigned to experimental and control groups and the researcher worked with the existing intact classes. Secondary school classes once constituted exist as intact groups. According to Shuttleworth (2009), the design allows the researcher to exert complete control over the variables and to check the influence of pretest on the results. The design controls major threats to internal validity except those associated with interactions of maturity and history, selection and maturation and selection and instrumentation (Cook & Campbell, 1979). Random assignment of schools to experimental and control groups controlled selection and maturation. To control interaction between selection and instrumentation, the conditions under which the instruments were administered were kept as similar as possible across the schools. Solomon Four-Group design is as follows:

Group I (E1)	O ₁	Х	<u>O2</u>	
Group II (C1)	O ₃			O_4
Group III (E2)			Х	O5
Group IV (C2)				<u>O</u> ₆

Key: O1 and O3 are pretests; O2, O4, O5 and O6 are posttests; X is the treatment.

Group I was the experimental group (E1) which received the pretest (O₁), the treatment (X) and the posttest (O₂). Group II was the control group (C1) which received a pretest (O₃), no treatment and the posttest (O₄). Group III was another experimental group (E2) which received treatment (X) and the posttest (O₅) but did not receive the pretest. Group IV was another control (C2) that received the posttest (O₆) only. Group 1 and III were exposed to CAT strategy. Group II and Group IV were taught agriculture using the conventional teaching strategy.

Data Collection and Analysis

The study target the 1,779, 876 secondary school students in Kenya. The study was carried out in Tharaka Nithi County, Kenya. The county has a total of 136 secondary schools comprising of 2 national, 14 extracounty, 29 county and 91 sub-county secondary schools. County secondary schools that had well equipped computer laboratories participated in the study. The accessible population was the 8,140 form one students in secondary schools in the county. Form ones were selected because the topic on Livestock Production I (Common livestock breeds) is taught at this level (KIE, 2006).

Stratified random sampling technique was used to select participating schools. A total of eight schools consisting of four girls' and four boys' secondary schools formed the sample for the study. A total of 163 boys and 164 girls participated in the study. Simple random sampling technique was used to select a particular stream for data analysis in cases where there was more than one stream in a participating school. However, for schools in the experimental groups, treatment was administered to all the streams.

The research instrument used for the study was Agriculture Achievement Test (AAT). The AAT was constructed from what the students had learnt during the study period. The researcher developed the AAT using the objectives of the topic being taught (MoE, 2012). Livestock production I (Common livestock breeds) formed the topic for the study. Livestock breeds studied included, cattle (exotic and indigenous), sheep, goats, rabbits, poultry and camels. The agriculture achievement test included short answer and structured questions covering knowledge, comprehension, application and analysis levels in the cognitive domain. The test had 17 items with a maximum score of 50 marks. To ascertain the reliability of the AAT, a pilot study was carried out in the neighbouring Embu County. K-R 21 formula was used to estimate the reliability of AAT. A reliability coefficient of 0.7 and above was accepted. The AAT yielded a coefficient of 0.91 which was considered suitable for the study.

The researcher trained form one agriculture teachers in the experimental groups for one day on the use of CAT strategy in teaching. Teachers in the experimental groups taught agriculture by use CAT strategy while their counterparts in the control groups taught agriculture by use of Conventional Teaching (CT)

strategy. The topic of instruction was Livestock Production I (Common livestock breeds). All the teachers in the sampled schools used a common implementation schedule which was prepared by the researcher. Before commencement of the study, agriculture achievement test was administered to groups I and II as a pretest. This was followed by a three weeks intervention of the CAT strategy for groups I and III. After the intervention, AAT was administered to all the groups. Students' pretest and posttest results were scored to generate data for analysis. Data was analysed by use of descriptive and inferential statistics.

Results and Discussions

The study sought to find out whether there is gender difference in achievement in agriculture among students exposed to CAT strategy. To determine whether there was gender difference in achievement after students were exposed to CAT strategy, AAT pretest and posttest mean scores were analysed on the basis of gender. Comparisons were then made to determine whether there was a significant difference on the mean scores of male and female students. Table 1 presents the pretest mean scores and standard deviation of AAT on the basis of gender.

Table 1				
Pretest Mean Scores Obtained by Students in AAT by Gender				
Gender	Ν	Mean	Standard Deviation	
Male	40	7.56	2.44	
Female	42	7.00	2.22	

Results in Table 1 show the mean score for male and female students was 7.56 and 7.00, respectively out of a maximum score of 50 marks. These scores are low probably because the testing was done before the content was taught in class. To determine whether there was a significant difference in the mean scores before the intervention, an independent t-test was performed. Results of the t-test are presented in Table 2. Table 2

The t-test of the Pretest AAT Mean Scores Obtained by Students by Gender				
	t	df	Sig. (2-tailed)	
Equal variances assumed	1.069	80	.288	
Equal variances not assumed	1.066	78.399	.288	

Results shown in Table 2 revealed no significant difference in the mean scores of male and female students, t (80) =1.066, p>0.05. This implied that the level of achievement prior to administration of the treatment for the two groups was similar hence the two groups were equivalent before administration of CAT strategy. After the treatment, analysis of posttest mean scores obtained by students in the experimental groups was done on the basis of gender. Table 3 shows the mean and standard deviation of male and female students after exposure to CAT strategy.

Posttest Mean Scores Obtained by Students in AAT by Gender				
Gender N Mean		Standard Deviation	_	
Male	81	32.37	7.84	-
Female	82	30.16	5.43	

 Table 3

 Posttest Mean Scores Obtained by Students in AAT by Gender

Results presented in Table 3 show that male and female students had mean scores of 32.37 and 30.16 respectively. Male students attained a higher mean score than female students. An independent t-test was performed to determine whether there was a significant difference in the mean scores. Results are shown in Table 4.

Table 4

The t-test of the Posttest AAT Mean Scores Obtained by Students by Gender

	t	df	Sig. (2-tailed)
Equal variances assumed	2.095	161	.038
Equal variances not assumed	2.091	142.168	.038

Results shown in Table 4 show that there was a significant difference in the two mean scores, t (161) =2.095, p<0.05 in favour of the male students. This implies that the intervention was more effective on male students than on female students. This therefore, led to the rejection of study hypothesis (H₀1) which stated that there is no statistically significant gender difference in achievement in agriculture among students exposed to CAT strategy.

Findings of the present study are consistent with findings of Scofield (1991) on experimental evaluation of the effectiveness of a computer assisted instruction unit on sustainable agriculture. Male students attained a significantly higher mean score on the posttest than female students. Other studies in different subjects have shown that achievement gains by males tend to be significantly higher that the gains attained by females when taught by use of computers (Clarian, & Schultz, 1993; Hativa & Shorer, 1989; Neuwman, 1991; Olumide, 2013).

Findings of the present study differ from the findings of Kiboss, Ndirangu and Wekesa (2004) on the effectiveness of using computer-mediated simulations to teach cell theory. Findings of the study showed no relationship between the students' gender and their learning outcomes. Yusuf and Afolabi (2010), also reported no significant difference in performance in biology between male and female students exposed to Computer assisted Instruction (CAI) in either individual or cooperative setting. Other studies have also indicated no significant difference in mean score achievement between male and female students after exposure to CAT strategy (Dhindsa & Emran, 2011; Mudasiru & Adedeji, 2010; Okwuru & Achor, 2014). According to Jenks and Springer (2002), new studies should be carried out to clarify the effect of CAI in contemporary student environment.

Conclusion and Recommendation

The present study revealed that a significant difference existed in the mean achievement scores of male and female students in favour of male students after exposure to CAT strategy. Therefore male students benefit more than female students in terms of achievement when CAT strategy is employed in teaching agriculture. Although male students seem to benefit more from CAT,

agriculture teachers should be encouraged to incorporate CAT strategy in their teaching as a way of enhancing the teaching of agriculture, and consequently improve performance in agriculture.

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Remote and Safe Monitoring of Magnetic Fields Produced by

Transmission Lines in Areas of High Concentration of Lightning Strokes

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Abstract

Monitoring of magnetic and electric fields in high voltage transmission lines (HVTL) of power plants and substations (SEs) is contemplated by Brazilian Regulatory Standard 616/2014. The measurement procedures of the magnetic and electric fields in SEs must follow a methodology in case of continuous field monitoring of the power equipment where it is common lightning stroke incidences. These monitoring procedures must be carried out in such a way that the recording of electromagnetic fields is done without necessity of exposuring the technical team to irradiation from the equipment and machines generating electrical power. This paper describes a prototype which is able to produce data at a specified safe distance from the irradiating area. The experimental recorded data was acquired, processed, compared and analyzed in areas of more intense radiation levels, acceptable levels and safe levels. This work aimed to establish basis of a technological innovation for the continuous recording of electromagnetic data, trying to cover the surroundings of transmission lines in urban environments, close to the generating units and substation installations wherever the highest levels of magnetic field could be found.

Keywords: Magnetic field monitoring; overhead transmission lines; lightning stroke areas; monitoring electromagnetic waves.

1. Introduction

People interactions to electromagnetic fields (EMF) in the surroundings of overhead power lines (50 or 60 Hz) is a subject of concern and study since the end of the last century. Epidemiological studies have been inconclusive to associate exposition to extremely low frequency EMF (ELF) generated by exposure to electrical equipment and proximity of high-voltage transmission lines and certain types of cancers for the occupational population [1]. Also, the scientific community's is still concerned about exposurement to ELF magnetic fields manifested in several publications as the possible cause of other diseases such as Alzheimer's [2], biological effects by altering intracellular calcium homeostasis [3], changes in neuronal activity [4], disturbances in sleep quality [5], changes in skeletal development in rodent embryos, general

cancer, heart rate variability, behavioural changes such as suicide and depression, hypersensitivity, humoral cognitive changes such as those compiled by IARC International Agency for Research on Cancer [6].

Aware of the scientific community concerns and applying the Precautionary Principle [7] in an attempt to reduce possible effects of EMF on human beings, WHO has established the reference limits for the general and occupational public of exposition to the EMF-ELF levels drawn up by ICNIRP through some guidelines published in 1998 [8] and 2010 [9]. In the last update, Table 1 emphasizes that the reference levels to magnetic fields has had significant changes along the years.

ICNIDD CHIDELINES	Magnetic Field Density (µT)		
ICNIKP GUIDELINES	1998	2010	
General Public	83.33	200	
Occupational Public	416.67	1000	

Table 1. Reference levels adopted by ICNIRP for the magnetic field [8], [9].

The table information is worrying and after reviewing the survey conducted by the EMF-Portal in 2014, showing that less than 50% of 56 countries met WHO guidelines [10].

Other relevant information that must be considered is the electromagnetic field levels dynamics close to overhead transmission lines depends on many parameters such as: the configuration of the cross sectional of the transmission line; voltage level; load current and the effect of imbalances; conductor types; soil resistivity; and metal structure effects near power transmission lines, such as constructions and pipelines [11]. Therefore, the electromagnetic field generated by TL in the area under analysis should be estimated and simulated at the project stage to assure that the field intensities should not exceed the reference values specified by ICNIRP [9].

This paper presents some results of a prototype to estimate continuous and safe electromagnetic field irradiation in environments close to high alternating voltage and high frequency concentration levels, specifically in the vicinity of overhead power transmission lines.

2. Analytical calculation of magnetic flux density

Khawaja and Huang [12] reviewed the influence of magnetic flux density from catenary suspended between two transmission towers. The effect in point (x_o , y_o , z_o) of Figure 1 can be calculated using Biot-Savart's Law.

$$d\vec{B}_i = \frac{\mu_0 I_i}{4\pi |\vec{r}|^3} \left(d\vec{l}_i \times \vec{r} \right) \tag{1}$$

where $d\vec{l}_i$ can be decomposed in orthogonal coordinates as:

$$d\vec{l}_i = dx_i\hat{\imath}_x + 0\hat{\imath}_y + dz_i\hat{\imath}_z \tag{2}$$

with:

$$d\vec{l}_i = dx_i\hat{\imath}_x + 0\hat{\imath}_y + \frac{dz_i}{dx_i}dx_i\hat{\imath}_z$$
(3)

Catenary equation in coordinates system is:

$$z_i = \frac{1}{\alpha} (\cosh(\alpha x_i) - 1), \quad -\frac{L}{2} \le x_i \le \frac{L}{2}$$

$$\tag{4}$$

where α (conductor linear weight/traction) is a constant determinate by the transmission line mechanical parameters and *L* is the span between towers. Deriving (4) with respect to *x* we have (6).

$$\frac{dz_i}{dx_i} = \sinh(\alpha x_i) \tag{5}$$

Vector \vec{r} is given by (6).

$$\vec{r} = (x_0 - x_i)\hat{\iota}_x + (y_0 - y_i)\hat{\iota}_y + (z_0 - z_i)\hat{\iota}_z$$
(6)

In Figure 1 is shown a simplified representation of a TL to calculate $d\vec{B}_i$ at a particular monitoring point *i* as generated by one single generic phase conductor.



Figure 1 Assessment of the magnetic density B at the monitoring point.

In this analysis it is considered a differential magnetic field $(d\vec{B}_i)$ generated by a differential section

of length $(d\vec{l}i)$ at a distance (\vec{r}) , when a current (I) circulates through a phase conductor point (i).

Substituting $d\vec{l}i$ and \vec{r} in $d\vec{B}_i$, the magnetic flux density can be assessed for the conductor phase at (*i*) of the line transmission by (7). In this relationship are represented these three components in a simplified way.

$$\vec{B}_{i} = \frac{\mu_{0}I_{i}}{4\pi} \int_{-\frac{L}{2}}^{\frac{L}{2}} \begin{cases} \frac{\left[-\sinh(\alpha x_{i})(y_{0} - y_{i})\right]}{|\vec{r}|^{3}}\hat{\imath}_{x} + \\ \frac{\left[(x_{0} - x_{i})\sinh(\alpha x_{i}) - (z_{0} - z_{i})\right]}{|\vec{r}|^{3}}\hat{\imath}_{y} \\ -\frac{(y_{0} - y_{i})}{|\vec{r}|^{3}}\hat{\imath}_{z} \end{cases} dx_{i}$$

$$(7)$$

where μ_0 is the free space magnetic permeability, x_i , y_i and z_i represent the points (*i*) in the conductor position. Equation (7) characterize MF in point (x_o , y_o , z_o) originated by (*i*) conductor. The field density can be approximated through of (9), (10) and (11).

$$\vec{B}_{xi} = \frac{\mu_0 I_i}{4\pi} \sum_{-\frac{L}{2}}^{\frac{L}{2}} \frac{\left(-\sinh(\alpha x_i) \left(y_0 - y_i\right)\right)}{|\vec{r}|^3}$$
(8)

$$\vec{B}_{yi} = \frac{\mu_0 I_i}{4\pi} \sum_{-\frac{L}{2}}^{\frac{L}{2}} \frac{\left[(x_0 - x_i) \sinh(\alpha x_i) - (z_0 - z_i) \right]}{|\vec{r}|^3}$$
(9)

Substituting z_i from (4) in (9) results in (10)

$$\vec{B}_{yi} = \frac{\mu_0 I_i}{4\pi} \sum_{-\frac{L}{2}}^{\frac{L}{2}} \frac{1}{|\vec{r}|^3} \left[(x_0 - x_i) \sinh(\alpha x_i) - \left(z_0 - \frac{1}{\alpha} (\cosh(\alpha x_i) - 1) \right) \right]$$
(10)

$$\vec{B}_{zi} = -\frac{\mu_0 I_i}{4\pi} \sum_{-\frac{L}{2}}^{\frac{L}{2}} \frac{(y_0 - y_i)}{|\vec{r}|^3}$$
(11)

Equation (8) is equal to zero, (10) represents how the conductor catenary has influence on MF and (11)

is distance MF interference. Magnetic flux density \vec{B}_{yi} is the component that can be collected by the prototype and calculated by (10).

3. Approximated calculation of the magnetic flux density

An interesting simplified method for electric and magnetic field calculations was presented by Roscoe et al. [13]. It is based on the fact that the magnetic flux density B produced by the current circulating through a fraction of the conductor defined by dl can be calculated using the Biot-Savart's Law [14] showed in (1).

The Biot-Savart's Law in (1) can be transformed into the expression shown in (12), and it can be applied to calculate the magnetic field produced by an overhead power transmission with a current i_i .

$$dB = \frac{\mu_0 i_i}{4\pi b} (\cos \alpha_1 - \cos \alpha_2) \left(\frac{dl}{l} \times \frac{b}{b} \right)$$
(12)

where **b** is an orthogonal distance to dl, to a generic observation point from dl. The line length is defined by l. Angles α_1 and α_2 are defined between the beginning and the end of conductor dl, as the reference observation point, as can be seen in Figure 2.

The start point ("c") of the *dl* conductor is represented by $P(x_c, y_c, z_c)$, while the end point is identified by $P(x_{f_i}, y_{f_i}, z_f)$ on the 3 axes. The observation point of the magnetic field is arbitrary, being identified by $P(x_o, y_o, z_o)$.



Figure 2. Magnetic field density characterization by simplified way.

The calculation was performed considering dl, therefore the magnetic flux density obtained will be dB. Magnetic flux density that is obtained by (1), generates three components defined by \overrightarrow{dB}_x , \overrightarrow{dB}_y and \overrightarrow{dB}_z in three orthogonal axes as in (13).

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$$dB = (dB_x, dB_y, dB_z) \tag{13}$$

This expression is valid for a single conductor, but if there were several parallel conductors, the individual components must be summed in the *x*, *y*, and *z* directions, as shown in (14). The final equation will give the three components B_{sx} , B_{sy} as B_{sz} valid for the same instant of time, defined by *t*.

$$B(t) = \left(B_{sx}(t), B_{sy}(t), B_{sz}(t)\right)$$
(14)

Then B(t) can be calculated as (15).

$$B(t) = \left(\sum dB_{x}(t), \sum dB_{y}(t), \sum dB_{z}(t)\right)$$
(15)

The magnetic flux density vector modulus B at time t can be determined by (16).

$$|B(t)| = \sqrt{B_{sx}(t)^2 + B_{sy}(t)^2 + B_{sz}(t)^2}$$
(16)

Considering that the overhead power transmission line is a balanced three-phase system, and that the angles between current phases are $120^{\circ} (2\pi/3)$, currents i_1 , i_2 , and i_3 will have amplitude I_m and a ω angular frequency ($2\pi f$).

$$i_i = I_m \cos\left(\omega t - \frac{(i-1)2\pi}{3}\right) \to i = \{1, 2, 3\}$$
 (17)

The root mean square of magnetic flux density can be obtained from (18).

$$B_{rms}(t) = \sqrt{\int_{t-T}^{t} \frac{1}{T} B^2(\tau)}$$
(18)

The magnetic flux density magnitude *B* is defined by (18), T = 0.01666 s is the period, and τ is an auxiliary integration variable. These expressions were codified in Matlab, based on a simple tower structure to calculate the magnetic flux density modules, as it is presented in the following section.

4. Prototype Implementation

The parts of the prototype built for the experiments are shown in Figure 3, formed by 4 cylindrical iron rods of a 1 m length. Each bar has a diameter of 19 mm, coiled with 2450 turns of copper each.

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Figure 3. Internal structure of the prototype with exploded view showing the 4 iron bar rods with the copper turns.

Each solenoid was wound with a single layer. The copper wire has a diameter of approximately 0.4 mm and was wound onto a 1 mm thick PVC pipe, avoiding contact with the iron rod. The four bars are supported by two 1.8 cm Nylon 6.0, on which are resting the iron rods, fixing them inside the PVC tube of 7.2 cm in diameter. The outside of the tube has been covered with a ground aluminum foil film which was grounded during the measurement process. The only face of the unshielded aluminum tube was the face pointing the TL. The solenoid wire connections are in parallel and one of the covers was placed on the output terminal of the arrangement

The magnetic flux density can be obtained in the mounted structure by the Faraday's Law, by the expression of the open-circuit voltage V_{oc} , as can be seen in (19).

$$V_{OC} = 2\pi f \mu_{ef} N(\pi r^2) B \tag{19}$$

where B is magnetic flux density component in parallel to the axis of the arrangement, f is the operating frequency and r is the rod radius [15].

The core effective permeability μ_{ef} of the built solenoid can be replaced by the relative permeability of the material used in the core μ_r . Because there is not significant spacing between the solenoid and core winding, in (20) the solenoid inductance is calculated by

$$L_a = \frac{[\mu_0 \mu_r (\pi r^2) N^2]}{[l+0.9(r)]}$$
(20)

To transfer maximum power, it was used a low input impedance stage with the required impedance coupling. Considering that the load is resistive, the inductance L_a should be compensated by a capacitance, as determined by (21) at an operating frequency f.

$$C_s = \frac{1}{[(2\pi f)^2 L_a]}$$
(21)

Thus, load R_L must be equal to R_a , which is calculated by (24). Since the inductor generates an open circuit voltage V_{OC} under a magnetic field B, the output voltage V_{out} will be half the open circuit voltage given by (22).

$$V_{out} = \frac{1}{2} V_{OC} = \pi f \mu_r N(\pi r^2) B$$
(22)

The equivalent circuit is shown in Figure 4 as modified from the one presented in IEEE Std 1308 (1995b), without the parasitic capacitance, due to the low frequency of the existing signal (50 or 60 Hz).



Figure 4. Open circuit equivalent model between dotted antenna lines.

The output power per unit volume can be determined by using the core length of the following relationship:

$$\frac{P_{saida}}{V_{ol}} = \frac{\left(\frac{V_{oc}}{2}\right)^2}{\left[\pi r^2 h\right]} = \frac{\left[\frac{(\pi f \mu_r N(\pi r^2)B)^2}{R_a}\right]}{[\pi r^2 h]}$$
(23)

where h is the solenoid height, ρ is resistance per length unit of the used cooper wire.

Under the parameters of Table 2 for R_a , L_a and C_s used to compensate the equivalent inductance. The value R_a is obtained from (24).

$$R_a = \rho N(2\pi r) \tag{24}$$

Table 2. Parameters of the equivalent circuit.

$R_a(\Omega)$	$L_a(H)$	$C_s(\mu F)$
23.8	0.385	73,6

Replacing (24) in (23) and simplifying, results in (25).

$$\frac{P_{saida}}{V_{ol}} = \frac{2\pi^2 r N \mu_r^2 f^2 B^2}{4\rho l}$$
(25)

The expressions obtained in this section allow to configure the acquisition circuit, and to continue with the processing signal using the embedded circuit. Relation (25) allows an interesting notion of the output dependence on the solenoid geometric proportions.

5. Magnetic field measurements

In order to carry out the measurements of the EM fields of a distribution line of 13.8 kV with a gap between towers of 40 m, with a cable line with Sparrow type steel core, with a 100 A-circulating current. Magnetic field levels were referenced to middle point of the imaginary parallel line to the axis joining the two towers, following a perpendicular line to the two towers. Figure 5 shows the positioning pattern of the experimental prototype. Five field readings were performed on the 3 axes with a ICEL commercial meter model EM-8000 Series No. E8000.0121 (ICEL, 2008) and a Minipa digital oscilloscope, model MO 2250 DC.



Figure 5. Points for monitoring a transmission line.

Figure 6 shows the positioned prototype placed at a height of 1 m from the ground level, supported by a wooden tripod in order to minimize interferences on the measurements, following the IEEE Std 644 644 (IEEE, 1995). The prototype was positioned 1 m above the ground level on wood tripod in order to minimize any interference on the measurements. Readings started from a distance of 30 m and going ahead by 5 m steps until reaching the axes center, as seen in Figure 5.



Figure 6. Prototype placed in front of 13.8 kV distribution line.

The experimental distribution line used along the tests passes through the campus of the Federal University of Rondônia (Brazil) being one of the reasons for selecting it. This location offered sheltering from atmospheric discharges, protection against rainfall and it is away from any interference generated by any environmental conditioning equipment. The environmental conditions during the reading tests were: temperature at 35 °C and relative humidity of 86%.

The magnetic flux density generated by the line induced voltage on the prototype is detailed in (19). The voltage values obtained with this equation allow a comparison between the readings performed with the implemented prototype and the ones from the theoretical predictions under operating conditions shown in Table 4 of section VI.

Figure 7 shows the complete system to monitor the magnetic fields presented in this npaper. The basic circuit is emphasized with dotted lines, considering that induced voltage values are low in amplitude (nearly microvolts), the signal was then amplified and conditioned to be processed later by an embedded circuit able to process data to determine the value of B through (19).

Signal conditioning has been performed by the circuit shown in Figure 8. The circuit is composed of three stages. The first stage was implemented by the Texas Instrument amplifier INA122 with a CMRR = 90 dB; the second stage is an active fourth-pass bandpass filter with the center frequency at 60 Hz and a bandwidth of 40 Hz. The last stage was used to adjust the gain with an TL072 amplifier. Total circuit absolute gain owas equal to 500 or 54 dB with respect to the field level found at monitoring point.



Figure 7. Data acquisition circuit to perform the prototype readings.



Figure 8. Signal Conditioning Circuit.

Table 3 displays the level ratios and gains obtained by the signal conditioner circuit in order to avoid any signal distortions.

B [T]	V _{oc} [V]	Gain	V _{in} Embbed [V]
6.10-8	3.14.10 ⁻³	500	1.57
6.10 ⁻⁷	3.14.10 ⁻²	100	3.14

Table 3. Absolute circuit gains for different density levels of the measured magnetic flux.

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6.10 ⁻⁶	3.14.10 ⁻¹	10	3.14
6.10 ⁻⁵	3.14	1	3.14
6.10 ⁻⁴	31.4	0.1	3.14
1.10-3	52.4	0.01	0.524

For levels above 6 μ T, the circuit of Figure 8 required modifications, such as suppression of the last amplifier and a voltage divider arrangement for a magnetic flux density of 1000 μ T. The measured levels were compared to the calculated theoretical values as listed in Figure 9.



Figure 9. Magnetic Field levels for 13.8 kV distribution line.

Although the arrangement used during the EM measurements were not exactly an antenna, the prototype directivity was simulated through a computational simulation. The software chosen was the Ansoft's HFSS, ver 15.0. Thus, using a computer compatible with 8 cores, 28 Gb of RAM with the Windows operating system, version 10, and 15 Gb of disk free space to store the results obtained by the program, the graph of the directivity was plotted as in Figure 10.

With a driven voltage of 1 V and 60 Hz center frequency, according to the reciprocity law, the radiation pattern of a transmitting antenna looks like the receiving antenna diagram. The simulation started with 10 turns and increased during simulations up to 250 turns. After this number of turns the computational resources were not practical to finalize a more detailed simulation with success.



Figure 10. Directivity radiation diagram of the field generated by the assembled arrangement.

6. Results and discussion

Table 5 lists the magnetic flux density results obtained for distances between 0 and 30 m. In the second column of this table, is displayed the reference theoretical calculation considering the cable electrical physical parameters. In the third and fourth columns are shown the measurements obtained with the prototype and manual meter, respectively. The last column lists an approximation reached applying a 6-th order regression polynomial. The ratio in (26) defines the used polynomial expression.

$$ratio = \sum_{n=0}^{6} a_n d^n \tag{26}$$

where d is monitoring distance.

The ratio let to fit prototype values to theoretical levels at distances between 0 to 30 m as predicted by (26), with the residual sum of squares $rss = 5.451869222 \cdot 10^{-16}$, $R_2=1$ and the coefficients shown in Table 4.

Coefficient	Value
a_6	$1.555758547 \cdot 10^{-7}$
a_5	$-1.226720263 \cdot 10^{-5}$
a_4	$3.76711781 \cdot 10^{-4}$
<i>a</i> ₃	$-5.802067755 \cdot 10^{-3}$
a_2	$4.92151768 \cdot 10^{-2}$
a_1	$-1.994529988 \cdot 10^{-1}$
a_0	0.4325016518

Table 4. Coefficients values of 6th order regression polynomial.

They were calculated several lower approximations, nonetheless the 6-th order was the one which had a better approximation.

In Figure 10 is plotted the three first values of the magnetic flux density as compiled in Table 5. It can be seen that theoretical magnetic flux density had less variation than those values obtained by the prototype and meter used. The meter obtained a higher value because the z-component was more significant when positioned below the distribution line while the prototype had a lower level because of its proximity to the line. However, this difference in the first 15 m decreased with an exponential trend between 20 and 30 m, which is the proposed distance by this research.



Figure 11. Magnetic flux density plotted by theoretical calculation, prototype values and meter readings.

In Figure 12 is plotted the values of the theoretical and the polynomial approximations. The time was selected as reference for the theoretical comparative values because the input parameters were already known, as the line current, distance between towers and conductor type.

Table 5. Magnetic flux density levels obtained for a distribution line with current 100 A for distances between 0 to 30 m.

Dist. [m]	Theoretical [T]	Prototype [T]	Meter [T]	Approx. by a 6-th order poly [T]
0	2.227 10-8	5.15 10-8	2.60 10-8	2.227 10-8
5	2.137 10-8	1.53 10-7	2.10 10-7	2.137 10-8
10	1.901 10 ⁻⁸	7.5 10 ⁻⁸	9.05 10-8	1.901 10 ⁻⁸
15	1.593 10 ⁻⁸	3.46 10 ⁻⁸	4.00 10-8	1.593 10 ⁻⁸
20	1.282 10 ⁻⁸	1.86 10 ⁻⁸	7.00 10-8	1.282 10 ⁻⁸
25	1.009 10 ⁻⁸	1.14 10-8	6,00 10-8	1,009 10 ⁻⁸
30	7.869 10 ⁻⁸	3.09 10- ⁹	4.00 10-8	7.869 10 ⁻⁹



Figure 12. Theoretical magnetic flux density and values calculated by 6-th order polynomial approximation factor applied in prototype.

7. Conclusion

This paper proposes an implementation of a remote monitoring prototype of magnetic flux density with the use of materials easily found in local market. The prototype dimensions as presented here can be reduced with the use of core materials with higher magnetic permeability as observed in the equations as presented in Section 4.

The theoretical values of the magnetic flux density for distances greater than 20 m from the imaginary axis are very close to the values measured by the prototype.

The choice of a single axis structure to capture the magnetic field is based on the safety of the physical dimensions according the orders of magnitude of the signal to be monitored. It was observed that the selected local where the tests were performed presented a high index (9) of atmospheric discharges [16].

The approximate values obtained through theoretical equations provide an interesting estimative for the actual existing magnetic field density. Taking into account that the field density depends on the nominal current and on a few physical characteristics of the cables, it is concluded that there is a limited spacing for arrangement of the conductors and the height to support the 3-phase circuit.

The accuracy of the existing magnetic field calculations can be improved by using information from the substation's current transformer, which will allow to have better evaluation of the magnetic field produced by a real time current circulation through the TL.

8. Acknowledgement

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Synthesis and Conductivity Studies of Tetraarylphosphonium Salts As Potential Electrolytes in Advanced Batteries.

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Abstract:

The purpose of this study was to synthesize polysubstituted tetraarylphosphonium/tetrakis (pentafluorophenyl) borate salts **3**, also known as TAP^R/TFAB where R is a substituent, and to measure their conductance/conductivity in low-polarity media such as tetrahydrofuran (THF) and dichloromethane (DCM). Such determination was to provide a rationale to the question of whether these compounds, and other weakly coordinating cations/anions combinations are suitable electrolytes for advanced batteries which are energized in safer, low-polarity organic solvents.

Introduction

Battery technology is one of the important components in renewable energy to store produced energy. Liion battery has become a prominent technology while its use of metals could pose the problem of longterm stability, disposal, and handling.¹⁻⁴ In order to address the pressing issue of battery safety, other alternatives are actively being considered.⁵⁻⁶ Potential solutions include organic radical battery (ORB) and organic redox flow battery (ORFB).⁷⁻⁹ ORB uses organic radical polymers and electrolytes, which has a potential to be more environmentally friendly and more flexible than conventional metal-based batteries while maintaining or theoretically surpassing the capacity and charge density of Li-ion batteries. In pure ORB, organic radical polymers act as anodes and cathodes, which are separated by a porous membrane and submerged in electrolytes. ORFB consists of redox active molecules such as quinones and electrolytes dissolved in aqueous or non-aqueous solvents, which could achieve high energy density and good cyclability. Nonaqueous solvents with electrolytes can offer a wide window of electrochemical stability with higher cell voltage. In both ORB and ORFB, electrolytes act as a key component that allows the transport of ions between electrodes and enables charge balance. To date, a variety of electrolytes has been tested with varying ionic conductivity, but testing has been limited to readily available electrolytes.¹⁰⁻¹¹ Fewer efforts were made to explore other types of electrolytes that could achieve high ionic conductivity and stability in ORB and ORFB. In addition, only polar solvents are used generally due to reduced solubility of electrolytes and redox active materials in non-polar solvents. We hypothesize that electrolytes that can be used in non-polar solvents could expand the ability to test other redox active materials, which may help improve the performance of batteries. For instance, weakly coordinating anions (WCAs) and cations (WCCs) have potentials to improve the efficiency and stability of batteries over the existing and commonly used electrolytes by increasing and optimizing conductivity tailored to the redox active

molecules. WCAs and WCCs are a loose association of anions and cations where minimal interaction exists between ions. This can be achieved by building large and bulky cations and anions. Such loosely held ionpairs may thus lead to increased conductivity even in low polarity solvents because of their high solubility. At the same time, larger and bulkier ions, such as $[B\{C_6H_3(CF_3)_2\}_4]^-$ or TFAB, travel more slowly in a viscous medium than do smaller ions, which could limit conductivity while the association constants of TFAB-containing salts are much lower than salts containing smaller conventional anions such as hexafluorophosphate. WCAs are widely studied in catalysis and in electrochemistry although reports of their electrochemical usage as supporting electrolytes in non-polar environments and batteries are scarce.¹²⁻ ¹³ Recently, Mullen and Floudas have developed a novel class of WCAs and WCCs by polyphenylenedendrimerizing of tetraaryborate ions and tetraphenylphosphonium ions, respectively.¹⁴⁻¹⁸ While these rigid compounds have not been tested yet as supporting electrolytes for electrochemistry, the association constants of these electrolytes are lower than those of conventional electrolytes reported earlier. In the case of WCCs, higher generation dendrimers have been found to lower the association constants, presumably by shielding the core phosphonium cations from the periphery rather than delocalizing charges over the dendrimers. Dendrimerization works to make weakly coordinating anions/cations more conductive, but conductivity is only moderately improved in higher generation dendrimers. Thus, the choice of an adequate supporting electrolyte is paramount since the salt affects both mass transport and solution resistance in the aforementioned batteries.

Materials and Method:

Preparation of these salts followed a modified procedure by Charette et al.²³ As depicted in the general *Scheme 1*, substituted aryl halides underwent a palladium-catalyzed coupling reaction with corresponding triarylphosphines **1** in boiling *o*-xylene in order to yield novel substituted tetraarylphosphonium ylides **2** (STEP 1). The insoluble phosphonium halides precipitated in the *o*-xylene and were isolated from the reaction mixture by simple filtration. The subsequent metathesis reaction allowed an exchange of ions between the phosphonium ylide **2** and the lithium tetrakis boron pentafluorobenzene (Li⁺ TFAB⁻) salt, which resulted in the formation of lithium halide and the desired ion-pair tetraarylphosphonium-tetrakis boron pentafluorobenzene TAP^{R+} TFAB⁻ **3** (STEP 2). Synthesized compounds were characterized by various NMR spectroscopic methods.

Scheme 1: Synthesis of TPA^{R+} TFAB⁻.



Conductivity Measurements were made with a YSI 3200 conductivity bridge utilizing a YSI 3256 dip probe with a cell constant of 0.091 (0.004 cm⁻¹). The cell constant was calculated by repeat measurements

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of aqueous KCl solutions at two concentrations. The test solution was contained in a conductivity cell made by "sawing off" the top half of a 100-mL graduated cylinder. The diameter of this cell is normally set slightly larger than that of the YSI 3256 dip probe, thus minimizing the amount of solvent necessary for the experiment. Typically, 30 mL of solution were added to the conductivity cell and then stirred. The YSI 3256 contains a thermistor, and the temperature of the solution was recorded during each experiment. The temperature throughout an experiment remained consistent while the average temperature throughout the entire set of data was set to 22.45 (0.95 °C). Ten $100-\mu$ L aliquots of a nominally 3 mM stock solution of the electrolyte were added to the conductivity cell resulting in concentrations ranging from 10^{-5} to 10^6 M. After measurement of the final solution, the volume of solution in the conductivity cell was determined via the graduations on the graduated cylinder. In the case of tetrahydrofuran, the volume of stock solution added (1 mL) was compensated for by solvent evaporation. We were able to perform conductivity measurements on both newly synthesized electrolytes (R= *p*OCH₃ and R= *p*CH₃) for comparison with the automotive industry standards electrolyte salts: TBA-TFAB and TBA-PF₆.

Results and Discussion:

The central hypothesis of this study is that novel weakly coordinating cations (WCCs) salts, combined with [TFAB] as a WCA, are much more highly dissociated than the traditional electrolytes $[BF_4]^-$ or $[PF_6]^-$ in low-polarity solvents while at the same time retaining good transport properties.¹⁹ This increased solubility of new salts in low-polarity solvents can provide the impetus to explore alternative cations as new, high performance, less toxic electrolytes for ORB and OFRB. Although we are looking at cation sides specifically, our knowledge in dissociation constants of WCCs and WCAs in general and redox potential determinations in non-polar environments can be applied to a wider range of fields, including organic synthesis, energy, and even biology as mentioned. The energy community will benefit from the comprehensive results of this project. A new series of electrolytes could help us explore furthermore the effect of electrolytes and solvents, especially non-polar solvents, in ORFB and ORB, and it might be even possible to find some that work in actual batteries. The first requirement for electrochemistry of any kind, including those in batteries and common potentiostat measurements, is a conductive solution. Non aqueous solvents have become increasingly attractive as alternatives to aqueous media in the fields of metal deposition²⁰ and non-aqueous electrolyte batteries.²¹ Ion pairing was shown to be prevalent in such media and this necessitated the use of microelectrodes. The attractive energy E of the cation-anion interaction is related to the dissociative energy of the thermal motion $k_{\rm B}T$ (where $k_{\rm B}$ is the Boltzman constant while T is the absolute temperature) by the Bjerrum theory. This theory predicts that *ions might exist separately only*

if their size σ_{ion} exceeds a certain value, the so-called Bjerrum radius σ_B .²² Otherwise they would build

cation-anion pairs as the thermal motion would not be able to prevent their association at small distances. This condition can be satisfied in two different ways: 1) soluble molecules that can dissociate into large ions; 2) disassociation of small molecules with further solubilization of ions into larger micelles. In this project, we consider the first approach by preparing salts or "ion pairs" that, due to the bulkier sizes and the electronic properties of their constitutive ions, will disassociate into large cation and anion. Electrostatic

attraction pulls these cations and anions together creating the so-called ion pairs. They exist in dynamic balance between electrostatic attraction and destructive thermal motion. Enlarged ions size can prevent their [re]association into pairs of ions, creating disassociated "free" ions.

As depicted in the general *Scheme 1*, substituted aryl halide underwent a palladium-catalyzed coupling reaction with corresponding triarylphosphine 1 in boiling *o*-xylene in order to yield novel substituted tetraarylphosphonium ylide 2. The insoluble phosphonium bromide precipitated in the *o*-xylene and was isolated from the reaction media by simple filtration. The subsequent metathesis reaction allowed an exchange of ions between the phosphonium ylide 2 and lithium tetrakis boron pentafluorobenzene, resulting in the formation of lithium bromide and the desired ion-pair tetraarylphosphonium 3.

Scheme 2: Metathesis of tetraarylphosphonium halides with LiTFAB



Conductivity Measurements: We, then, performed electrochemical experiments to probe the effect of both the solvent and the synthesized electrolytes (TAP^{R+} TFAB⁻ ion-pairs) on conductivity. Indeed, nonand low-polar solvents can be made sufficiently conducting when these weakly coordinating anions/cations (i.e. the electrolytes) are dissolved in the solvent. Our goal was to determine the association/disassociation constants of these ions in solution. Ions associate in solution to form a stable entity in media of low permittivity because Coulombic interactions are greater than the thermal energies of the "separated" ions.²⁴ Molar conductivity was measured and plotted versus the concentration to show that: 1) At low concentrations, the conductivity decreased proportionally to the concentration, 2) At high concentration in low polarity solvents, a minimum was obtained, and 3) Weak electrolytes displayed a more rapid decrease in conductivity. Disassociation constants (*K_d*) were measured and limiting conductivity calculated for the different synthesized salts, with greater value obtained for **R= OCH3**, and generally, electron-donating groups enhanced conductivity by promoting disassociation of ion-pairs according to **Table 1**.

TAP ^R -TFAB Substituents	Disassociation	Limiting	Association
	Constant (K _d)	Conductivity (Λ₀)	Constant (K _A)
R= <i>p</i> OCH₃	2.29 x 10 ⁻⁴	90.1 Scm ² /mole	4.37 x 10 ³
R= <i>p</i> CH₃	2.03 x 10 ⁻⁴	68.80 Scm ² /mole	4.92 x 10 ³
TBA-TFAB TBA-PF ₆	1.20 x 10 ⁻⁴	83.3 Scm ² /mole	8.33 x 10 ³
	2.68 x 10⁻ ⁶	121.0 Scm ² /mole	373.13 x 10 ³

	Ta	ble	1.	Preliminary	conductivity	v data	for	TAP ^R -TH	AB	salts.
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Conclusion:

The long term goal of this project is to address issues related to renewable energy and its safe and sustainable conversion and storage in batteries for use in appropriate devices. The lithium-ion battery is plagued by issues either at the electrodes or the electrolytes. Organic Radical Batteries (ORBs) and Organic Redox Flow Batteries (ORFBs) are attractive because they present the possibility of fabricating lightweight and flexible devices with better safety and comparable or possibly better performance than lithium-based batteries for which increasing demands exist already.²⁵ The next decade will be characterized by an increase in use of grid-independent, portable electrical devices that are slim, with tunable potentials such as a battery-on-the package that would be easy and "green" to manufacture and to process, being made of resource-abundant organic material and environmentally friendly to dispose of.²⁶ We have designed a series of WCAs/WCCs which can offer in addition to the above-mentioned advantages, improved ions' mobility in nonpolar solvents for electrolytes that would enhance the specific capacity of ORBs and ORFBs. We expect to perform electrochemical measurement in non-polar solvents with electrolytes that are soluble in those solvents. We plan to use them to conduct pulse radiolysis studies to determine redox potentials of redox-active molecules such as those used in ORBs and ORFBs in non-polar solvents and, possibly to measure redox potentials in an electrolyte-free environment for the first time.

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Supplemental Data ¹<u>H NMR</u>:







¹⁹<u>F NMR:</u>



Evaluation of Students Scientific and Medical Literacy After Performing Laboratory Exercises in a Microbiology Laboratory for Non-Majors

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Abstract

Introduction to Microbes and Disease was designed to introduce students to the field of Microbiology, with a focus on medicine and disease. In this course, students develop a comprehensive understanding of the structure of biology of microbes and how the human immune system interacts with them to fight disease. All undergraduate students directed on a health science course path will benefit from this introductory course, but this course does not fulfill requirements for Biology majors. The newly developed course was developed in 2013 and was first offered in the fall semester of 2014.

Pre-assessment and post-assessment exams were used in the Microbes and Disease - Biology 2510 (Introduction to Microbes and Disease) for the spring 2017 semester in which the total enrollment was 140 students. In this study, the assessments were used to examine the confidence and competence in biological concepts and lab techniques in the biology lab course for non-majors. The assessments were evaluated quantitatively and qualitatively. Lab experiment reports were used to examine the collaboration and student-learning occurring in lab. Grades for individual assessments and laboratory reports were collected, and analyzed using Microsoft Excel.

Scatter plots illustrated the grade distribution of 98 pre and post assessments representing all students enrolled in BIOL 2510 for the 2017 spring semester. Differences between pre and post assessment grades and laboratory report grades are indicated by line charts These graphs also provided comparisons between the different lab sections.

This science education project addressed active learning themes, the importance of weekly lab write ups, collaborative group work and confidence and competence of biological concepts and laboratory techniques..

Introduction

The nursing program at North Carolina Central University is well respected and as a result is in high demand. Introduction to Microbes and Disease, is "a course designed to introduce students to the field of Microbiology, with a focus on medicine and disease. Students will develop a comprehensive understanding of the structure and biology of microbes and how the human immune system interacts with them to fight disease" (North Carolina Central University Course Catalog). Laboratory exercises, quizzes, and the lab report (identification of an unknown organism) are reinforcements of the concepts discussed in lecture. The

laboratory provides and opportunity for examination of organisms through use of different microbiological techniques., that are geared toward expanding biological knowledge.

A deep learning approach allows students to understand the subject matter, beyond what is originally presented to them, thus engaging with the topic and interacting beyond the usual acceptance of authority (Cranston, et al. 2015). A surface learning technique differs in that students tend to take a far more narrow approach to their education (Prosser and Trigwell, 1999). Further more, surface learning can be encouraged by populated class sizes. Large class sizes have been studied for many years by various science education researchers. The impact of class size on student learning and achievement have been reported, (Walker et al, 2008; Leight et al. 2012) to possibly cause some students academic challenges related to large enrollment well before an examination is given. This behavior in some cases encourages passive student behavior in acquiring knowledge, poor attendance, and minimal effort to develop the needed study skills.

Techniques to encourage deep, interactive student learning are best employed in a laboratory setting (Cranston et al; 2015). The laboratory experience can be viewed as a space to alleviate student passiveness and encourage participatory learning. Labs provide an environment that promotes student collaboration ensuring that their learning experience is maximized. More importantly, research shows that active participation is an important factor in the achievement of deep learning, whilst a passive reception of knowledge takes a more basic education route (Stranger-Hall, 2012).

Active learning practices in the laboratory that include inter-personal activities can help the students regain their level of attention and connection with lecture material (Lujan et al., 2012). When applying active learning strategies, in the lab, students are given more learning responsibilities and as a result become more actively engaged in the educational process (Rivaz et al., 2015). These experimental practices encourage deep learning and allow the focus to be on understanding and comprehension, before evaluation and the worry of lecture tests. More importantly, an active deep learning lab approach may minimize the uncertainty and guessing probability on assessments (Walker et. Al., 2008).

In cooperative laboratory experiments, students are encouraged to work collaboratively in small groups to achieve a common goal rather than individual grades (Armstrong et al., 2007). Students work together in small groups or pairs (Ruddick, 2013), and listen and understand the viewpoints of their peers. The students in these lab groups can become intrinsically motivated to work collaboratively on an experiment, and foster deep learning (Sandahl, 2009). It is believed that students in these groups can support each other not only intellectually, but also emotionally, to accomplish a shared goal (Giuliodori et al., 2008). They can use effective methodology to elaborate on the material in a more familiar way to help improve the understanding of other students (Armstrong et al., 2007). Collaborative learning is being utilized in various disciplines such as biology, geoscience, and psychology; and is gradually becoming more common at some universities (Gilley & Clarkston, 2014). For example, Leight et al. (2012) reported findings suggesting that the students who work collaboratively pool their knowledge and understanding rather than just rely on the top student to provide all of the answers. Similar results were reported by Cortright et al. (2003), Gilly & Clarkson (2014), and Rivaz et al. (2015). Cranston et al (2015) demonstrated that deep learning in the laboratory setting prompts students to truly analyze and understand various

scientific phenomenon, while supporting ongoing learning and developing necessary experimental practice. The students' constructive interactions with peers and instructors, significantly correlated with improvements in lab report grades, and the acquisition of critical thinking and problem solving skills as examined in the in-class assessments.

This experiment was not the typical blind study, as I was aware of the experimental motive and procedure. However, the students in each lab class were unaware of the assessments used or the specific organization of each lab grouping.

The rationale for this study conducted over the course of two consecutive semesters (Fall 2016, Spring 2017), is based on students being paired in groups made up of students scoring high on the preassessment and students scoring below the average on the pre-assessment. The goal was to identify Students Scientific and Medical Literacy After Performing Laboratory Exercises in BIOL 2510: Introduction to Microbes and Disease. We also wanted to investigate the role of collaborative lab exercises that were being used to promote a deeper understanding of the laboratory content. Therefore, it was essential to optimize the level of scientific laboratory technique understanding of Biology non-majors in BIOL 2510. This was done by the following:

(a) examining the difference in preliminary and post assessment grades in all laboratory sections of BIOL 2510 (sections 01-04)

(b) collecting quantitative data on the effects of blind student pairing via post-assessment outcomes;

- (c) comparing individual laboratory post experimentation reports for three major experiments
- (d) comparing final laboratory grades for all student enrolled in BIOL 2510 (Spring 2017);
- (d) assessing the impact of collaborative laboratory experiments using post-assessment grades.

Methodology

Course Description:

The study conducted here is based upon the findings of the Biology 2510: Introduction to Microbes and Disease. This course is specifically for Biology non-majors seeking admittance into nursing school. This is a one credit hour class designed for students in allied health programs. It includes preparing stained smears, culturing micro-organisms, conducting immunology experiments, performing tests to identify bacteria and studying microbial growth control methods.

Course Evaluation:

In BIOL 2510, the non-Biology majors meet for 10 weeks of consecutive lab experiments. The lab course makes up 100 points out of a 400 point course. Each lab is worth 5 points for the pre-lab write up and 5 points for the laboratory post-lab write up. Pre and post assessments were used as attendance checkers for the initial and terminating lab meetings for the semester. And, were also graded to be used as an evaluation of student learning and understanding.

Assessment Format:

The format of the Pre-assessment consist of five introductory questions, followed by twenty-five International Educative Research Foundation and Publisher © 2018 pg. 126

	Objectives:
a)	Demonstrate safe practices in a
	microbiology laboratory
b)	Explain and correctly demonstrate use of
	the scientific method
c)	Demonstrate proper usage, identify the
	parts/functions of the following
	microscopes
d)	Transfer living microbes using aseptic
	technique
e)	Demonstrate proficiency and use of
	laboratory techniques (streak plate
	isolation technique; \mathbf{E} bacterial staining
	techniques; wet mounts; and proper
	culture handling)
f)	Visually recognize and explain the
	macroscopic and microscopic
	characteristics of bacteria
g)	Understand and explain environmental
	factors that influence microbes

multiple choice questions which examined the students basic knowledge of biology as well as confounding microbiology objectives. The objectives that were tested are as listed in the table below:

Students completed pre-assessment test during the first week of classes, and were paired based on their scores to ensure optimal collaborative and active learning practices. Students who high performing (scoring 80% or higher) were paired with students who performed lower (80% or lower). Students were not aware that they were specifically grouped by score.

The post assessment that was administered followed the same rubric. All twenty-five multiple choice were identical to the pre-assessment questions. However, the preliminary questions regarding grade, expected occupation, etc. were not included in the post-assessment. The students were not made aware that both assessments were identical.

The purpose for giving the same assessment at the beginning of the semester and at the end was to measure a change in score in order to test the effects of blind student pairing and collaborative active learning in a laboratory setting.

Laboratory Reports:

In BIOL 2510, the laboratory report grades for all ten laboratory experiments were analyzed to determine the effects of active and collaborative learning in the lab classes throughout the semester.

Students were encouraged to discuss lab tactics and objectives during class time to ensure they reported and expounded upon the correct information in their weekly lab reports. All laboratory report grades were recorded and three specific labs were plotted for comparison. These labs were selected due to their topics, (Gram stain, bacterial titration, and antibiotic sensitivity testing) including main microbiology objectives important to the biology non-majors, such as the nursing students.

The laboratory report template for BIOL 2510 is as follows:

Title: The title should be concise and specific and tell the reader what you did

<u>Purpose:</u> Most lab reports do not include a formal introduction and instead substitute a purpose. The purpose of the experiment should be stated in one or two sentences. You should know the purpose of the experiment before you start.

<u>Methods</u>: Most lab reports do not include all the details a journal article requires. Normally the procedure can be listed and referenced to the appropriate laboratory manual pages. If modifications have been made to the methods in the lab manual, these need to be clearly described.

<u>Results:</u> All data and observations should be included in the lab book; however, what you think should have happened or the methods section are not included. Types of results may include:

Measurements- Report measurements using standard metric units. Any time a number is presented, it must have units. Numbers should be written as numerals when they are greater than ten or when they are associated with measurements; for example, 8 mm or 20 g. In a list of objects including both numbers over and under ten, all numbers may be expressed as numerals. Example: 17 bacteria, 2 yeast, and 1 protozoan. If a number starts a sentence spell out the number, do not use a numeral. Example: ten mannitol salt agar plates were streaked...

(If necessary) Calculations: The equation should be indicated. In a lab report, even if you use a calculator, you must set up the problem.

(If necessary) Tables: Number each table and provide a title and legend that contains all the information needed to interpret the data. The reader should be able to understand the content without the text. The title should be located at the top of the table. Columns and rows should be labeled clearly.

Figures- Figures include graphs, photographs, drawings, and diagrams. All figures should be numbered and have a title and legend that contains all the information needed to interpret the data. The reader should be able to understand the content without the text. Figures should be labeled at the bottom. If the photograph is of an object under the microscope, the total magnification should be indicated.

(If possible/necessary) Plate counts. Include results for all dilutions, even if they are too numerous to count (TNTC) or 0. You should indicate the type of medium plated and temperature of incubation. See Table 1. <u>Discussion/Conclusion</u>: The discussion section interprets the meaning of the results and draws conclusions from the data that have been presented. If data can be interpreted in more than one way, all possibilities should be mentioned and the authors should indicate which alternative they think is correct and why. Results should be discussed even if they are unexpected or negative. For example, the presence of unexpected bands on agarose gels should be explained. This section should also address any discrepancies in the results. The meaning of your results should be summarized in two to three sentences at the end of

the section. In lab reports, experiments do not always work. This section allows the researcher to explain what might have gone wrong with an experiment.

Data Collection and Analysis:

The grades that the students received for pre and post assessments were entered in excel alongside the grades obtained from lab reports and final lab grades for spring 2017 laboratory students. The following comparative analyses were conducted:

- 1. Comparison of original assessment with post assessment average grades between all four laboratory sections, illustrated by a Figure 1.
- Comparison of laboratory report grades for three specific labs outline key objectives from the following labs: LAB 3 (gram staining), LAB 6 (Titration of bacteria), and LAB 9 (Antibiotic sensitivity testing). This data is portrayed using a Figure 2.
- 3. Comparison of final laboratory grades between all four sections during the spring 2017 semester is illustrated in Figure 3.

Results

This project included a total of 84 students who were enrolled in BIOL 2510: Introduction to Microbes and Disease course, in the Spring 2017 semester. Data collected from students in the 2017 spring semester laboratory sections generated a set of results on (a) the students in each section who completed the pre and post assessment, (b) laboratory report grades for three specific labs outline key objectives in the labs 3 (gram staining), 6 (Titration of bacteria), and 9 (Antibiotic sensitivity testing), (c) final laboratory grades between all four sections during the spring 2017 semester for 10 consecutive labs. The number of students included in each of the following result section was 84 in total. All of the students were enrolled in one lecture section taught by the same instructor. All laboratory sections were taught by Biology graduate teaching assistants. Laboratory section 1, taught by lab teaching assistant Chioma Azih had 20 students. Laboratory section 2, taught by lab teaching assistant Maya Barlow had 22 students. Laboratory section 3, taught by lab teaching assistant Erika Baker had 24 students, and laboratory section 4, taught by lab teaching assistant Margie Stringfield had 22 students.



Figure 1: Average pre and post assessment grades for students enrolled in BIOL 2510. Spring 2017

Fig 1: This figure illustrates the grades of all 84 students across the four laboratory sections. There is a clear increase in post assessment grades in 3 out of 4 sections taught by four different teaching assistants.

Figure 2: Average laboratory report grades for labs 3,6,9: Gram staining, bacteria titration, and antibiotic sensitivity testing labs, respectively.



Fig 2: These labs were performed three weeks apart from one another and illustrated continued learning and knowledge building with specific concepts.

These three specific laboratory reports were chosen for evaluation due to their importance and relevance to Microbiology for BIOL 2510, according to the objectives on the course syllabus.



Figure 3: Average final lab grade for each section of BIOL 2510

Figure 3: Each lab sections average illustrates that most lab grades were between A averages (90-100) and B averages (80-90).

For this science research project, it is understood that the only evaluations conducted and analyzed were among the spring 2017 laboratory cohort. However, as the instructor for the fall and spring lab course I would like to insert the final grade comparison for the fall 2016 and spring 2017 laboratory course. This will possibly shed light on the impact of grouping students, as this practice was not introduced until spring 2017.



Figure 4: Comparison of average final lab grades between Erika's 2016 and 2017 laboratory classes

Figure 4: The spring 2017 final laboratory grades are slightly higher than fall 2016 final laboratory grades.

This is interesting due to the fact that, the same instructor, using the same laboratory experiments, taught both courses; the variables- lab team grouping and collaborative lab procedures.

Discussion

After the results of this study were compiled, examined, and analyzed, three major themes emerged from this project, (a) the enhancement of assessment and laboratory report performance as a result of collaborative learning, (b) the benefits of strategically grouping students in teams to optimize learning, (c) the students reaction to collaborative learning and lab practice in BIOL 2510.

There are several national and international pedagogical studies that have been and are currently being undertaken to address the enhancement of STEM student learning. Each section was allotted an example lab report to layout the type of report was expected, along with the template. The students made it clear that they were not familiar with hands-on labs and writing lab reports. Therefore, resources were given to them to ensure their success in the lab sections. Communicating with students was key to capitalizing on their active and collaborative learning experience.

In this study the collaborative learning techniques were illustrated through ten interactive learning laboratory experiments for all sections of BIOL 2510. All 84 students completed an individual pre-lab write up based off of the provided lab experiment protocol posted each week and then completed the in-class interactive lab with their assigned group members, followed by the post-lab report.

(a) The enhancement in student performance was observed in the post assessment exam averages as well as the lab report averages. The difference between the post and pre- assessment averages plotted in figure 1, show noticeable increases in averages for scores for three out of the four laboratory sections. When the individual assessment grades were plotted we were able to see one particular students great increase 10 points. It was also noted that there were very few students who scored lower on the post-assessment than on the pre-assessment.

(b) The students sitting through BIOL 2510 were new to the setting of an interactive experimental hands-on lab. The lab TAs worked with students on interactive experimental procedures, following proper lab protocol, and scientific deep thinking. This course offered students exploratory opportunity in the field of active learning and hands on science in the microbiology field in these three major areas:

1. Arranging specific groups to set students up for optimal active learning practices and collaborative learning students who scored less than 80% stated that they were not confident about the foundational biological concepts in which they needed to build on to be successful in this course.

2. In figure 2, we can see gradual increase in post assessment grades for three main experiments which extrapolated major objectives in the microbes and diseases course for pre-nursing majors.

3. There were a few cases in figures 1 and 2 where a drop or decrease in academic performance but the overall grades illustrated by figure 3 portrays overall scientific understanding and positive collaborative effects of interactive learning in the BIOL 2510 scientific laboratory course.

(c) The reactions of the students during lab experimentation time was sometimes truly priceless. They were really intrigued by the experiments conducted throughout the semester. Labs 3 - Gram Staining; Lab 6 – Bacteria Titration; and Lab 9 – Antibiotic Sensitivity Testing, were among some of the favorites. Often times, they would collaborate and bounce ideas off of one another. The scientific thinking and active learning skills really developed as the semester progressed.

This research experiment provided the BIOL 2510 lab with the first assessment (outside of the student rating of instruction) since the course was implemented in 2013. The findings in this experiment could improve the quality and productivity of the lab to better aid the pre-nursing students in the future. For instance, there should be active learning feedback opportunities, reflections, and feedback from the students on how to improve the course. Perhaps, the most informative tool would be a questionnaire to get the opinion of the student on what they believe works best. Lastly, this lab would be more relevant if the experiments were more geared toward the nursing specialty as it pertains to laboratory procedures.

Conclusion

In conclusion, the science education research aspect was intellectually sound and informative despite certain challenges. The intrinsic variability in the data sets was fully recognized in this research activity in that (a) the average of the laboratory grade indicated the probable benefits of active learning and collaborative classroom but suffered from the fact that there weren't previous grades to collaborative lab grades available for comparison, (b) the TA-to-TA variability within each lab report grade may have made it harder to examine the impact of active learning in the lab but the technique for each TA is constant within their specific lab. These differences were taken into account when analyzing data. It was evident that this

active learning exercise of implementing blind collaborative groups in the BIOL2510 benefited the students in more ways that just enhancing their grade. However, this lab style benefit in a single course may be much more fully realized and intensified when subsequent courses in the 4-year course also utilize this active learning and assessment practice.

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Appendix

1. Assessment Form

Assessment Questions:

Subjective:

1. First and last name?

- 2. What is your current Major?
- 3. What is your desired career?
- 4. What subjects in biology are of most interest to you?
- 5. What do you hope to learn in this class?
- 6. How prepared do you feel for this course?

Objective:

- 7. Which of the following is **<u>not</u>** considered a microbe?
 - A. bacterium
 - B. alga
 - C. mushroom
 - D. protozoan

8. 40.When a trait is not expressed but is carried in the DNA of an individual it is said to be ______. (1 point)

- A. not expressed
- B. hiding
- C. dominant
- D. recessive

9. 4.Suppose that a group of scientists accepts a theory as offering a convincing explanation of observable data. Ideally, how should those scientists react to new data that appear to contradict the theory? (1 point)

A. They should let the public decide whether the new data are convincing, because science should be democratic.

B. They should investigate whether the new data are accurate, because every theory is open to analysis.

C. They should ignore the new data, because the new data are most likely incorrect.

D.They should accept the new data, because data are facts and facts are more certain than theories.

10. 8.Dr. Flores tested the effectiveness of a flouride gel on reducing the number of cavities in humans. He applied the gel to 50 test subjects, each of whom had cavities in the past. After 6 months, the number of new cavities in the subjects had decreased.

Dr. Flores's study was flawed. What did it lack? (1 point)

A. a sample

B. a dependent variable

C.an independent variable

D. a control group

11. Which part of the skeletal system offers protection? (1 point)



- A. femur
- B. rib cage
- C. pelvis
- D. vertebrae

12. Which of the following is not found in animal cells? (1 point)

- A. Cell Membrane
- B. Ribosomes
- C. Chloroplast
- D. Nucleus

13. Which of the following is listed in order of highest level of organization to lowest level of organization? (1 point)

- A. tissue, cell, system, organ
- B. system, organ, tissue, cell
- C. organ, cell, tissue, system
- D cell, tissue, organ, system
- 14. Which of the following is not a reason for a cell to divide? (1 point)
 - A. Repair
 - B. Hunger
 - C. Reproduction
 - D. Growth

15. Science can be influenced by race, gender, nationality, or religion of the scientist. (T/F)

- 16. The use of sterile techniques and agar media enabled early microbiologists to:
- a. study pure cultures
- b. demonstrate the nature of infectious disease
- c. study mixed cultures
- d. study agar-metabolizing cultures
- e. disprove spontaneous generation
17. What type of cell is this?



- A. amoeba
- B. animal
- C. plant
- D. bacterium
- 18. Plants get the energy they need to grow from the
 - A. air
 - B. water
 - C. sun
 - D. soil
- 19. A plasmid is a small, circular DNA molecule carrying genes of interest (T/F)
- 20. The proposed mechanism that explains the observable patterns of evolution?
- A. Darwinism
- B. Natural selection
- C. Specific selection
- D. Selective breeding
- 21. Central idea to Biology?
- A. DNA \rightarrow RNA \rightarrow Protein
- B. RNA \rightarrow DNA \rightarrow Protein
- C. Protein \rightarrow RNA \rightarrow DNA

D. RNA \rightarrow Protein \rightarrow DNA

- 22. What skill is a scientist using when she listens to the sounds that whales make?
 - A. making a hypothesis
 - B. drawing conclusions
 - C. making observations
 - D. interpreting data
- 23. In an experiment, the one variable that is changed is called the?
 - A. controlled variable
 - B. independent variable
 - C. dependent variable
 - D. experimental variable
- 24. What are the correct order of steps in the scientific method?
 - A. ask a question, make a hypothesis, test the hypothesis, analyze results, draw conclusions, communicate results
 - B. make a hypothesis, test the hypothesis, analyze results, ask a question, draw conclusions, communicate results
 - C. ask a question, analyze results, make a hypothesis, test the hypothesis, draw conclusions, communicate results
 - D. ask a question, make a hypothesis, test the hypothesis, draw conclusions, analyze results, communicate results
- 25. All of the following are examples of involuntary reflexes except?
 - A. breathing
 - B. raising your hand
 - C. blinking
 - D. heartbeat

26. During cellular respiration, the majority of energy that is released occurs in the cell's?

- A. mitochondria
- B. nucleus
- C. ribosomes
- D. cytoplasm

27. When water passes through the cell membrane because of diffusion, its called?

- A. cellular respiration
- B. photosynthesis
- C. osmosis
- D. water treatment
- 28. When a cell takes in a particle by surrounding it, this is called?
 - A. engulfing
 - B. eating
 - C. passive transport
 - D. entrapment
- 29. Where does glycolysis take place?
 - A. cytoplasm
 - B. mitochondrial matrix
 - C. chloroplasts
 - D. mitochondria

30. If you wanted to determine the phenotype of an organism, what procedure would you follow?

- A. Observe physical characteristics
- B. DNA sequence the parents
- C. DNA fingerprint the organism
- D. Do a dihybrid cross
- 2. Lab Syllabus (attached below)

Laboratory Schedule:

Week 1: Pre-assessment & Syllabus Overview

Week 2: Microscopy, Observation of Stained Specimens, Aseptic Technique & Culture Transfer

Week 3: Aseptic Technique and Gram Staining of Bacteria, Streak Plating, Technique, Phase Contrast

Microscopy

- Week 4: Pure Culture Isolation/Streak Plating, Bacterial Conjugation
- Week 5: Bacterial Conjugation
- Week 6: Titration of Bacteriophage
- Week 7: Selective and Differential Media, Nasal Flora

Week 8: Spring Break

- Week 9: Disinfectants and Antiseptics, Antibiotic Sensitivity Testing
- Week 10: ABO Blood Typing
- Week 11: Effects of Hand washing/ Post Assessment

General Lab Objectives:

 \Box \Box Demonstrate safe practices in a microbiology laboratory.

- \Box \Box Explain and correctly demonstrate use of the scientific method
- \Box \Box Demonstrate proper usage, identify the parts/functions of the following microscopes.

□ □ Transfer living microbes using aseptic technique.

 \Box \Box Demonstrate proficiency and use of the following in the laboratory: streak plate isolation technique; \Box bacterial staining techniques; wet mounts; and proper culture handling.

□ □ Visually recognize and explain the macroscopic and microscopic characteristics of bacteria.

Understand and explain environmental factors that influence microbes.

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Human Capital Development and organizational performance: review & critique of literature and A research agenda

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ABSTRACT

Given the competition in organizations and Technological trends in the current labour markets firms considering to grow and retain the position, demand and supply for labour in the market has been saturated. The bargaining power in the market depends on skills and scarce resource available. Different theories in relation to human capital have been articulated. Most organizations would want to employee people who will add value to their organizations in terms of production in order to achieve competitive advantage. Different pay rates are applied depending on the qualification of individual, for the organization to invest in employee's development they will assess how they are going to benefit. The aim of this study was to find out how human capital development affects firms performance. Based on published literature and past studies analysis was done to support the study, there was appositive link between HCD and firms performance so to retain and maintain the flow of skills the organization needs to invest in human capital to curb the mass exodus of people going outside the country to look for jobs and patients being taken outside the country for treatment while they can get the same service here. Exploratory research design has been recommended for future research.

Keywords: Human capital, development, Management, Firm Performance

1.0 Introduction

Human Capital Management (HCM) is how a person can carry out work using the skills and knowledge acquired in order to add value to the country's economy. (Kearns 2005) describes it as a to Human Resource Management from the traditional approach. HCM deals with analyzing the obtained data and report it so as to give direction of importance to management of people in order to have strategic investment in the firm and to be able to make better decisions. Management regards HCM as an asset and uses Metric as a tool of measure to guide them so as to achieve a competitive advantage by investing strategically in these human assets through developing them giving them more work so as not lose them (retain them) making

use of employee to be useful and productive in the firm, managing talents and offering more learning programmes (Armstrong. 2006)

Economies of developing and developed countries depends on human capital development, this will include building the process through which inculcation of relevant skills. Technical knowledge and effectiveness to meet set goals is known as HCD (Obadan and Adubi 1998). Sengupta 2011 "a major paradigms shift favouring economies with knowledge has been shown in economic growth, human capital has substituted industrialization Research and Development (R&D) has been driven by human capital hence a pillar of countries economy"

Human capital has its historical origin in the *Political economy journal of 1966* by B.F. Kiker and published in the Journal of Political Economy in 1966. human capital was traced from the 17th century to demonstrate the power of cost on lost life in war and other death. The contributors of Economics of Human Capital suggested methods of investments in human beings in order to generate return, They included (Jean Say Baptiste 1821, Adam Smith 1776, Roscher William 1878, John Stuart Mill 1909, Sidgwick Henry 1901). Throughout the studies the evolution of Theories addressing Human Capital issues have been used in public policy matters which remain the subject that is studied in the theory today, theory today, this included the powerful Nation that invest in education for a productive Nation both with skills and knowledge

Human Capital has been emphasized on in organizations this reflects the how the market value relies on less resources that are tangible, but on intangible resources, especially human resources. Attracting, employing and retaining the right employees, fulfills this equation. The organization can develop skills by encouraging employees to continuously emprase learning by encouraging and supporting them and creating a conducive environment. Human Capital is defined by OECD (2001) as competencies, skills, knowledge and attributes that individual posses that enables them to create social, personal and economic value. Human Capital are important aspects in work force and production hence they need to have formal learning to acquire knowledge, on job traing to gain skills and compitencies to perform work and leadership qualifications

The success of every organization depends on Human capital Mahroum (2007) had suggested that the capacity to develop talent, deploy it and continuously attract it depends on human capital management to be competitive and have an advantage over other firms. With the changing technological trends and globalization most employees would want to be associated with an organization that has a name in the market. Human capital is the key pillar for of any organization to succeed. Mahroum (2007) suggested that human capital management is based on main specific capacities which included, talent development, talent deployment and capacity to attract talent from elsewhere. This capacities help the organization maintain a competitive edge in the market.

Failing to have human capital development makes it hard for workers to deliver the quality of products that customers need. Currently in Kenya, the demand from clients for higher quality of, education, health and skilled labour is also causing concern in the labour market, about lack of skills and should lead to a new interest in training. Again, the influx of patients being taken to foreign countries for treatment (cancer patients) and qualified personnel like Teachers, Engineers, Doctors and Nurses opting to work in foreign countries, It is in this regard that, this dissertation seeks to look into the effect of human capital development and firm performance in Kenya the focus will in Public Hospital's

2.0 Literature review

2.1 Theoretical review

Human capital theory: The intangible assets an individual possess that is knowledge and skills, are used to raise individual values economically for themselves, employer plus the society at large. Investment in Education pays off in terms of **human capital** higher productivity. The human capital theory emanated from the theory of macroeconomic development (Schultz 1993) education is given important preference. According to Becker we have different kinds of capitals which includes medical care expenditures, computer training, and schooling. He teaches on time management, being honest are also investments

Human capital considers labour as an item that can be bought and sold. This theory concentrates much on exploiting labour. Education and training makes employees acquire skills, expertise and knowledge needed to perform, which is more valuable so a lot of consideration has to be given it in terms of investment in people. To distinguish firms specific and general human capital, general is gained is through education while specific is done through areas of expertise like, Accounts, engineers. Therefore training is considered a special investment in employees (human capital).

Resource Based view Theory:For a competitive advantage to be attained a company has to strategically place itself to counter the external forces in the environment so as to position itself in the market. There the internal resource which includes Human Capital has to be acknowledged as a crucial resource to be sustained effectively (Wright *et al* 2001).Resource Based View (RBV) was started by the works of Penrose (1959), the many researcher articulated to it like Barney (1995). The RBV articulates the needs for an organization developing valuables resources and put them together so as to succeed in a unique way, other resources in the organization can be imitated examples use of Technology, availability of natural resources but Human Capital's knowledge cannot be imitated because each person has special uniqueness (tacit knowledge) hence rare and difficult to copy or imitate so they are valuable resources within the organization though its an asset that can't be seen (Itami 1987)

If all employees with different talents are put together and managed well through Human Resource process (Training and development, reward management, employee relations etc.) then the organization positions itself strategically in a rare manner. That is unique compared to its competitors, most organizations creates barrier's

for imitation (guarding that rare resource they have) and cannot be acquired in the market easily they strive to keep resource they by retaining and continuously improving them through Training and Development.

Social Capital theory:Nahapiet & Ghoshal (1998), described social capital theory as what puts together the resources are valuable how they relate in social affairs and networks, knowing each other mutually, this brings efficiency on they act since they cooperate and behave in a similar manner, hence the relationships they socially can have appositive influence on the development of human capital intellectually, both at an individual level 'networks with people with similar characters, professions' (For example Doctors meeting at their joints or social clubs during their leisure time to network and share ideas ,new acquaintances to current and changing trends). This develops human capital (Garavan et al 2001). At an organizational level social capital is very important since intellectuals exchange ideas that are useful in the running of the organization. So networking is key since you learn from other new knowledge and information that is needful and creates identity, i.e. you identify yourself with a particular social class this connections cannot be imitated they are rare and they last based on trust, building a pool of knowledge and creating value

Evolutionary Growth theory:Nelson and Winter (1985) Viewed Evolutionary growth theory as a biological emerging in economics, that's something that is coming up in upcoming firms would want maximize profits subject to the level of knowledge they have, so they have to improvise ways of doing business in order to make them capture and retain the market, so when it fails it becomes difficult to rejuvenate it given the competition surrounding them. So will look for something closer, to what they had initially and if it succeed then it will survive and if not then it's eliminated. The essence of this theory is like an experimental exercise in the new product economic growth so human capital needs to learn do more research hence becomes an important asset in the organization

2.2 Empirical review

Human Capital Development: Importance of Human Capital depends on the degree of its contribution towards the creation of competitive advantage. Schultz 1993 views HC as an element that improves employees and firms assets so as to improve productivity and compete in the market, The practice of training of professional, imparting learning in order to acquire skills, knowledge and ability for the employee to be satisfied in order to be motivated to perform. The skills and knowledge person holds will allow them to work for economic value. (Romer 1990) defines HC as a major source of economic growth in the country hence meet targeted level of living standards hence the drive behind sustainable economic development it's the main pillar of economic growth which 'has (either acquired or inbuilt) components; knowledge and education got through education, competence, skills and expertise that be earned through on job training and practice (apprenticeship), Human capital concept arose from recognition of individual firms to invest in its human capital by Training and sponsor for education outside the firm in institutions, as you cannot go wrong in education and the best investment. This includes payment of fees for tuition and training, the employee or organizations strives to gain a return on investment. Wealth maximization both

on individual and organization can be expected on return on investment is greater than market rates or expected rate of return after investing on human capital.

Training and Development: Michel Armstrong (2001) describes Training is a systematic growth of knowledge, attitude and skills an individual needs to work. Edwin flippo (1984) views Training as a way of adding skills and knowledge needed to work, therefore Training is concerned with acquiring knowledge and skills hence its aprocess of learning, according to Aswathappa (2000) Talents are developed renewing the old ones and new employees are given jobs, hence training is a continuous process to enables employees perform their jobs effectively

Training Needs Analysis (TNA) is done so as to identify needed areas to be trained. Training plans are developed that suits the needs; knowledge needed to perform the jobs can be evaluated after training to ascertain if they have been acquired. Training is an important element int human capital development. The growth a person realizes in his ability is Development, and the programs are usually done in phases of planned study and experience, and coaching is done to support it Development happens when more experience gained is conceptualized to show its confidence gained for acting and how to relate to such action (Bolton, 1995).

Job Rotation : Job rotation is the shift of employees in various positions within the organization so as to fulfill various Human Resource objectives like enriching the employees, new employees getting acquainted to their areas of work, developing career, employees learning avoiding getting bored and reducing burnout. The Job Rotation plans involves employees in temporary tasks in a particular department and for a short period as assigned duties of that positions. It's a voluntary task and it's treated as part of their normal jobs. According to Edward (2005) job rotation is the movement of employees from one job to another within the organization so as to build on employee's values and capability in the firm

Employees given new assignment to perform on temporary position for a specific period is Job Rotation. This enables employees to be exposed and are able to perform in various capacities. This is an advantages to the organization such that in the absence of a particular employee work continues as employees are enriched with skills to perform in any capacity. Job Rotation was first established in Denmark in the 1980s, and may be put in use in many to fulfill development needs of companies and workers without disrupting the firm's process. Job specialization is concentrating on one job in one's ability hence the opposite is job rotation. Human Resource Development Council (HRDC 1997) views Job Rotation as strategy to develop individuals career which is learned in a temporary position of a particular job HRDC encourages employees to retain their position or designated duties a part from performing other tasks in the organization. This enables the employees to work all round and have knowledge of all areas in the organization.

Career Planning and Development: Career planning is a sequence of employment one explores in their abilities and plans strategically to achieve their goals so as to succeed by continuous learning for growth. Career employment that one can hold during the course of his lifetime. Schermerhorn (2002)" defined

Career planning as a systematic way of matching career goals as individual is able to acquire to fulfill their dream . it started in USA in 1970s and its process that enables employees to grow and identify opportunities as one develops themselves they can be promoted to higher positions, hence growth on individuals who work hard and this is a another way of motivating employees, this avoids employees from stagnating in one position. In order for the organization to prosper it needs to develop its employees

Knowledge Management:Knowledge is only asset that an employee can offer to the firm in the current competitive environment so as to have an edge over the competitors (Prahalad & Hamel 1990). Knowledge can be offered on individual basis or can be part of management system concept, Back and von Krogh (2003) viewed Knowledge as an on going transist in a logical process as follows capturing and initiating, they learn from each other and using it. knowledge management contributes to high production the organization as one the cost-cutting element in a competitive environment (Thompson 2003). Human resource management (HRM) Views knowledge management as part of its functions because it is about people and its part of HRM. (Evans 2003) analysed knowledge management as an entity of mapping intellectual assets within the organization. Studies is a process of learning so as to acquire skills, knowledge, values. Beliefs and habits for competitive advantage.

Education: Education is the sequence of learning as to acquire, skills, knowledge values, beliefs, and habits. Human characters and behavior are molded and shaped, methods to deliver education may include, discussion, storytelling, teaching, training, lecturing directed research. And its guided by the Educators or facilitators, but learners may also do the research and educate themselves, it can take be formal or informal way and through Education employees can be Developed to improve in performance and it helps individuals to tell between the true and false

Skills:An ability and capacity to know how to perform a particular job, ways to relate with others in a smooth manner. Skills can be acquired through learning either formal or on job training like apprenticeship

The Relationship between Human Capital and Firm Performance: Organizations and persons are focused on by human capital. Garavan et al (2001) views Human Capital to encompasses, Personal Competencies, adaptability and flexibility, organizational competencies for development and personal employability and these adds values to both employees and organizational results. (Nordhaug, 1998) attributes to different views have incorporated HC with a firms competitive advantage that can be sustained for higher performance. Doucouliagos (1997) Motivates employees, raises their morale plus engagement to perform, a lot is invested on Research and Development which gives room to acquire knowledge and skills. And for upcoming employees to grow so as to improve the economy and the society benefits. Seleim et al., (2007) studied on how HC relates with organizations performance. This argument was studied by Dooley (2000) who got similar results. It has established a positive relationship and hence paves way for greater innovation for firm's performance.

Dependent variable

3.0 Conclusions and future research direction

Proposed Conceptual Framework

It is used present a preferred approach to a thought. Likewise conceptual frameworks direct the collection and analysis of data. It refers to the organization of ideas set forth to achieve a study or a research project's It's the way ideas are organized to achieve a research project's goal (Shields & Rangarajan, 2013).

Figure 3.1 Conceptual Framework Independent Variable



MODERATOR

Source author 2017

Proposed Methodology

The study will adopt exploratory research design. As suggested by the previous researchers and being the basis of the Gap by previous researches The data collected will both qualitative and quantitative. Questionnaire will be administered with both closed and open –ended questions will be of essence to this study. The data will be collected through questionnaires to allow the researcher to come up with any perceived differences in Human Capital Development and organizational performance.

Research Gap

Human capital development plays a major role in organizations in trying to enhance performance. However little has being done to show that there is need to develop and retain the employees, Most studies has focused on Training as the Main Component of Human Capital Development, Little has been done or focused on the labour Markets as when we have many Trained people out in the Market with fever jobs this may lead to people opting to go and work outside the Country, Little has been talked about Pay and structure so to retain the employees, so most Firms would Develop there employees just as ground to gain experience then they move for greener pastures, on that note apart from Training as has been emphasized a lot should be looked into Labour Markets and Pay structures however there is indeed a relationship between Human Capital Development and organizational performance in most countries.

Most Organizations have emphased on human capital development which reflects the view that market value depends less on tangible resources, but rather on intangible ones, Main human resources. Getting (recruiting) and keeping (retaining) the best employees, however, is only part of the equation. The organization also has to leverage the skills and capabilities of its employees by encouraging individual and organizational learning and creating a supportive environment where knowledge can be created, shared and applied.

Empirical studies confirms research findings, giving strong links on the employment of graduates, even professional scientists and engineers, with the adoption and use of high-level technologies in the firm, and between the extent of investment in worker training with the current Technological Trends where Technology has to be embraced (Pfau and Kay, 2002; Low and Kalafut, 2002). This confirms the fact that more Educated and Skilled employees will easily adopt to Technology and merge the current labour Trends and efficiently perform in competitive environments (Low and Kalafut, 2002). Both informal and formal education play a major role in the ability to be innovative and creative on the job.

This paper has explored the concept of human capital development and organizations performance. From literature it has emerged that a relationship between human capital development and organizations performance exists, The direction of any future research is then invited to demonstrate in detail how the relationship between human capital development and organizations performance can be worked on as we have seen from the above gaps and this creates research agenda for further studies

Conclusions

The purpose of this study was to find out the relationship between executive Human Capital Development and organizational performance, to analyze the contextual, theoretical and methodological gaps and provide a conceptual framework of the relationship. This was to analyze the significance between the existing literature on Human capital Development and performance as established. Human Capital Development has become very necessary as most firms would want to perform better than the others, because of competition, Lack of human capital development makes it difficult for workers to deliver the quality of products that more discerning customers require. Currently in Kenya, the demand from clients for higher quality of, education, health and skilled labour is also causing concern in the labour market, about lack of skills and should lead to a new interest in training. Again, in the case of health Sector the influx of patients being taken to foreign countries for treatment (cancer patients) and qualified personnel like Teachers, Engineers, Doctors and Nurses opting to work in foreign countries causes. More so, the methodological gaps need to be bridged to make the studies relevant. It is hoped that the conceptual framework, methodological gaps and propositions will stimulate further research on Human Capital Development and its relationship to organizational performance to be relevant. Hence i recommend for future research.

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Strategy to promote research and innovation in the pharmaceutical sector through interdisciplinary education

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Abstract

Health products and services innovation have a strong economic and social impact, particularly by a BRICS member such as Brazil, considered the 6th largest consumer market for pharmaceutical products. Among the many national strategies to address the vulnerability of the country in this aspect, it is the training of the pharmacist one of the key players in the innovation process. In 2017 Generalist Pharmacy Curriculum Guide was published, which includes innovation, entrepreneurship and interdisciplinarity for the first time as components of the Brazilian pharmacist training. The present study analyzed 3742 disciplines currently offered by 42 universities, taking as a parameter the requirements induced by the new curriculum guideline. The method used was the content analysis, supported by NVivo® software, which generated 113 categories of disciplines, distributed in 8 core areas and 9 areas of knowledge. The result showed there is insufficiency related to health care and health management core areas as well as hours of internship, while there is predominance of health technology (> 75%) with only 2% of innovation besides inexpressive presence of entrepreneurship and interdisciplinarity. The study demonstrates that paradigmatic and substantial changes must be made by Universities in order to comply with the new Curriculum Guide and proposes strategic solutions to promote innovation from an interdisciplinary perspective.

Keywords: innovation, education, interdisciplinary, health, entrepreneurship, pharmacy.

1. Impacts of innovation in the pharmaceutical sector

Health is the third of the seventeen Sustainable Development Goals, established in 2015 (WHO, 2015), and innovation in pharmaceuticals can play an important role in health and well-being maintenance. Philip Abelson, a former editor of Science magazine, acknowledged that pharmaceuticals have accounted for about half of the improvement in health care during this century (ABELSON, 1993). In addition, there is currently a significant paradigm shift in the treatment of diseases and drug options. The genomics, transcriptome, proteomics and bioinformatics have been part of the scientific and business routine for some time, present in the drug development and intended for personalized and preventive treatment (BODROVA, 2012).

Pharmaceutical innovation is a source of intra-industry competitiveness and generates important impacts on the health economy. As BRICS's member, Brazil is the 6th largest pharmaceutical market in the world,

but still shows a clear distance from the world technological frontier (LUPIN LIMITED, 2017; CASSIOLATO, 2015). Even with the unique Brazilian biodiversity, its pharmaceutical market is still characterized by the importation of technologies and copies of medicines, which is insufficient as a development strategy and counterproductive from the point of view of strengthening national innovation systems (GADELHA et al., 2013; SCARAMUZZO; NIERO, 2013).

From any point of view, the university generates knowledge, especially when it is aligned with social needs (CHUNLIN LI, 2016). The university-industry interaction allows the exchange of experiences and knowledge, which almost always results in the development of new products or services, or in the solution of technical problems (LEE, 2000; SANTORO, 2000). This idea, however, is not peaceful, since there are authors who believe that this type of interaction corrupts the university, which must have isonomy, independence and autonomy for its research (ELMUTI, 2005; BERCOVITZ; FELDMAN, 2008).

Rocha (2012) highlights to the excessively academic character of the Brazilian universities, which hesitates to patent its research results, still operating much more in the 'publish or perish' than in the 'apply or perish' logic. In the context of the pharmaceutical industry, however, the patent plays a key role in the research process. The emergence of the concept of open innovation, brought by Chesbrough (2006), could even be a mitigator of such a cultural conflict, if it would not be needed the existence of a mature local innovation system, which is not the Brazilian case, particularly among pharmaceutical sector. The academic myth that patent deprives society of drug access is not true since patent support the advance of the state of the art. In the pharmaceutical industry, 90% of innovations, on average, are only marketed with patent protection (ALBUQUERQUE, 1998; DEMAIN, 2001; JANNUZZI, 2008).

This conservative and linear view, still prevalent in Brazil, has been questioned by nonlinear models of innovation, such as Triple Helix of Leydesdorff (2000), Etzkowitz (2008) and others, which gives the university a prominent role in the economics of trade, until the national innovation systems of Nelson (1993) and Dosi (1999), which consider all the institutionality involved in the process, beyond the mere market, reaching the mesoeconomics sphere.

Despite this, the impact on the economy has motivated the Brazilian government to depend less on drugs of external origin. An important initiative in this sense was the publication of Law no. 10.973/2004 (BRAZIL, 2004), known as the "Law of Innovation", updated by Law 13.243/2016 (BRAZIL, 2016), which became known as the "Legal Framework for Science, Technology and Innovation", both responsible for the creation of mechanisms for greater university-industry interaction. These initiatives come to the need of pharmaceutical innovation system that is still immature, disjointed and needs stimulation to the practice of innovation through the interaction between the industry sector, universities and research centers (MCTI, 2016; CRUZ, 2011; SCHWAB; SALA-I-MARTIN, 2010; VIEIRA; OHAYON, 2008).

Another important initiative of the Brazilian government was the creation of Productive Development Partnerships (PDPs). Regulated by Ordinance 837 of 2012 (BRASIL, 2012), the PDPs seek to reduce dependence on the country by enabling public laboratories to produce strategic medicines through the technology transfer from partnerships with private labs with expired patent. However, some partners have faced problems during their driving and even succumbed to various problems, including the need for more skilled workforce. This is the challenge that the present article will address by bringing together elements coming from the interdisciplinary education (SUNDFELD; DE SOUZA, 2014; REZENDE, 2013).

1.1. Challenges of pharmaceutical innovation and the interdisciplinary teaching

As drug's professionals, pharmacists are co-responsible for the population health and well-being and thus are a kind of "social entrepreneurs." In this sense, it is necessary to nurture the entrepreneurial spirit and innovative skills in undergraduate pharmacy students to promote future health care (BRAZEAU, 2013; COPE, 2005; STINCHCOMB, 2010; GENERAL, 2011).

Innovation is a specific consequence of entrepreneurship (DRUCKER, 1998; SCHUMPETER, 1954) and, although millenary and important, does not receive enough attention from academia. There are no single disciplines to gain a comprehensive view of the role played by innovation in social and economic aspects, what makes indispensable an interdisciplinary perspective (FAGERBERG, 2003).

Since the 1970s, Jantsch (1970) has said the university would have to adopt interdisciplinary approaches. Interdisciplinarity does not mean denying the discipline or specificities of each profession, but rather respecting the cognitive territory of each field, distinguishing points that unite them and points that differentiate them (GRAY, 2005; SAUPE; BUDÓ, 2006). The purpose is for a broader, non-fragmented knowledge, opened to dialogue and the interaction of disciplines and not a knowledge beyond multidisciplinarity, which operates only by juxtaposition and accumulation of knowledge (GARCIA et al., 2007; GATTÁS; FUREGATO, 2006). The interdisciplinary requirement induces the specialties to transcend their own areas, becoming aware of its limits and accepting contributions from other disciplines. This is the way of the university of the 21st century (BILILIGN, 2015).

The perception of this need was recognized by the recently Generalist Pharmacy Curriculum Guide, published through Resolution 6/2017, which establishes new curriculum guidelines for pharmacy courses in Brazil which will have two years to be in compliance with. For the first time, since the previous curriculum guide of 2002, undergraduate pharmacy program should consider interdisciplinarity, entrepreneurship and innovation in the formation of the Brazilian pharmacist (ANDERSON, 2002; BRAZIL, 2017).

Following a global trend of curriculum revision, in which developed countries aims to prepare pharmacy students for future innovations in personalized medicines, information systems and team patient care, and which developing countries seek the practice of pharmacy focused on patient and public health to achieve

universal access to essential medicines, universities in various countries have been reviewing their curriculums. Examples are universities from the United States, Europe, the Philippines, China and Australia (ANDERSON, 2002; ANTIGUA et al., 2015; ASSESORIA, 2017; CUNHA et al., 2016; FIP, 2013; ZM et al., 2014; WIEDENMAYER 2006).

The reality and possible strategies for the various countries, however, are quite different. According to Rampelotto (2016), the use of biodiversity, biomedicines, biotechnology and even pharmacogenetics is already considered a real opportunity for Brazil and emerges as a new paradigm for sustainable health development in the long term. Health education in Brazil is marked by the fragmentation of knowledge, hospital / biologicist vision and use of traditional teaching models, which prioritize a superspecialization and sophistication of the procedures (GONZALEZ; ALMEIDA, 2010; HADDAD, 2008). Therefore, the Brazilian pharmacy curriculum will suffer changes that can led the country to find their own trajectory to prepare interdisciplinary pharmacists for a new era of partnerships, research and development of new drugs and therapies that benefit the patient.

In this context, and considering the Brazilian government's objectives of stimulating health innovation and reducing external dependence, this study intends to analyze the current undergraduate pharmacy program in face of the political, economic and academic challenges that are posed, by the following objectives:

- Identify gaps of current pharmacy curriculum compared to the new Generalist Pharmacy Curriculum Guide (Resolution 6/2017) which is composed of 3 core areas distributed in: 50% of health care, 40% of health technology and innovation and 10 % of health management, excluding internship and additional activities, which must correspond to a minimum of 20% and a maximum of 3%, respectively, of the total course workload of at least 4000 hours. In addition, the course should consist of at least 50% of pharmaceutical sciences as area of knowledge;

- Mapping the current presence of disciplines related to the innovation of pharmaceutical products and services, from an interdisciplinary and entrepreneurial perspective.

Considering the precarious literature related to the subject, this study would provide reflection opportunities to the universities and to the Brazilian government regarding adjustments in the preparation of an interdisciplinary and entrepreneur pharmacist capable to promote products and services innovation, according to the demand expressed by the UN Sustainable Development Goals.

2. Methodology

The research had an exploratory character, involving the qualitative analysis of the disciplines present in pharmacy curriculum programs. The study universe was the list of pharmacy universities present on the Brazilian Federal Pharmacy Council website (CFF, 2017). The study took place through the following steps:

- 1- **Mapping**: the curriculum of each university was consulted in their respective websites to map all disciplines offered by the pharmacy courses;
- 2- **Coding**: the disciplines were analyzed through the content analysis procedure (BARDIN, 2009) for correct coding in "macro-disciplines". The nVivo® software was used to analyze the titles of the disciplines and, when they were not sufficiently clear, the syllabuses were consulted and fully analyzed for correct codification.
- 3- **Classification**: after codification, the disciplines were meticulously categorized into 2 (two) classifications (I and II), based on the definitions presented in Resolution 6/2017 and the objectives of the present study, as demonstrated by Table 1 below:

Classification I:							
Time distribution between the main priorities (health care, health technology and innovation, health							
management), internships and additional activities							
	Resolution 6/2017 describes as: "health care is understood as the set of actions and services offered to the						
Health Care	individual, the family and the community, which considers the autonomy of the human being, its singularity and						
neatti Care	the real context in which lives, and is carried out through activities to promote, protect and recover health, in						
	addition to preventing diseases, and enabling people to live better. "						
Haalth Taabaalagu	Resolution 6/2017 describes as: "health technology is understood as the organized set of all scientific, empirical						
Health Technology or intuitive knowledge, used in research, development, production, quality and provision of goods and servi							
	Resolution 6/2017 describes as: "health innovation refers to the solution of technological problems, including						
	the introduction or improvement of processes, products, strategies or services, having positive repercussions on						
Health Innovation	individual and collective health ". This definition is also aligned to the Oslo Manual (OECD, 2005), definition.						
	Expressed together with Health Technology by RE 6/2017, this area will be evaluated independently in this						
	study, to meet the proposed objectives.						
Haaldh man a ann an	Resolution 6/2017 describes as: "health management is understood as the technical, political and social process						
neatti management	capable of integrating resources and actions to produce results".						
Internship	"Supervised school education act, developed in the work environment, aimed at preparing for productive work"						
	(BRASIL, 2008).						
	Additional activities have the purpose of enriching the teaching-learning process which can be the participation						
A 1 1·/· 1 /· ·/·	in educational events such as: academic weeks, congresses, seminars, lectures, conferences, cultural activities;						
Additional activities	completion of extension courses and / or academic and professional updating; scientific initiation activities, as						
	well as monitoring (BRASIL, 2003).						
	These are the disciplines:						
	- Electives (those of free choice of the student to compose his / her curriculum to attend a more personalized						
Undefined Content	training of the future professional) (FRAUCHES, 2012).						
	- Disciplines where the title was not clear (eg, "Special topics") and which the syllabuses described as "varied						
	content".						
Multidisciplinary	Disciplines of other courses not related to any of the priorities of the pharmacy course.						

Table 1. Classification according to core areas and areas of knowledge

Classification II:									
Distribution by a	Distribution by areas of knowledge (including pharmaceutical sciences, interdisciplinary disciplines,								
entrepreneurs	entrepreneurship and research and development for product processes and services innovation).								
	Resolution 6/2017 describes as disciplines of: "ethics and bioethics, integrating the understanding of social								
Social and Human	determinants of health, which consider social, economic, political, cultural, gender and sexual, ethnic-racial,								
Science	psychological and behavioral factors, environmental, health-disease process of the individual and the population								
	а.								
	Resolution 6/2017 describes as disciplines that: "cover the fields of chemical, physical, mathematical, statistical								
Exact Sciences	and information technology sciences, which comprise their theoretical and practical domains, applied to the								
	pharmaceutical sciences"								
	Resolution 6/2017 describes as disciplines that: "cover molecular and cellular bases, the structural organization								
	of protists, fungi and plants of pharmaceutical interest, the physiological, pathological and pathophysiological								
Biologic Sciences	processes of the structure and function of tissues, organs, systems and of the devices, and the study of infectious								
	and parasitic agents, risk factors and protection for the development of diseases, applied to practice, within the								
	life cycles. "								
	Resolution 6/2017 describes as disciplines that: "cover the field of collective health, organization and								
	management of people, services and health system, programs and indicators of quality and safety of servic								
Health Sciences	health policies, health legislation, as well as epidemiology, communication, health education, integrative and								
	complementary practices that consider the social determination of the health-disease process "								
	Resolution 6/2017 describes as disciplines of: a) pharmaceutical assistance, pharmaceutical services,								
	pharmacoepidemiology, pharmacoeconomics, pharmacovigilance, haemovigilance and technovigilance, at all								
	levels of health care; b) pharmacology, clinical pharmacology, pharmaceutical semiology, pharmacological and								
	non-pharmacological therapies, clinical pharmacy, toxicology, clinical-pharmaceutical services and procedures								
	aimed at the patient, family and community, pharmaceutical care and patient safety; c) pharmaceutical and								
	medicinal chemistry, pharmacognosy, chemistry of natural products, phytotherapy and homeopathy; d)								
	pharmacotechnical, pharmaceutical technology and processes and pharmaceutical, master and industrial								
N . 10.	operations, applied to allopathic, homeopathic, phytotherapeutic drugs, cosmetics, radiopharmaceuticals, food								
r narmaceutical Sciences	and other health products, planning and development of inputs, drugs and medicines and cosmetics; e) control								
	and quality assurance of pharmaceutical products, processes and services; (f) deontology, health and professional								
	legislation; g) Clinical analysis, covering the domain of processes and techniques of areas such as clinical								
	microbiology, applied botany, clinical immunology, clinical biochemistry, clinical hematology, clinical								
	parasitology and clinical cytopathology; h) genetics and molecular biology; i) toxicological analyzes, including								
	the control of the processes and techniques of the different areas of toxicology; j) management of pharmaceutical								
	services; k) hospital pharmacy, pharmacy in oncology and nutritional therapy; l) analyzes of water, food,								
	medicines, cosmetics, sanitizing and household cleaning products.								
Research and	Resolution 6/2017 describes as disciplines of: "research and development for innovation, production, evaluation,								
dovelopment for product	control and quality assurance of inputs, pharmaceuticals, medicines, cosmetics, sanitizers, household cleaning								
innevetion	products, products and inputs biotechnologicals, biopharmaceuticals, biochemicals, immunobiologicals, blood								
mnovation	components, blood products, and other biotechnological and biological products, in addition to those obtained								

	by pharmacogenetics and pharmacogenomics, inputs and equipment for clinical-laboratory, genetic and						
	toxicological diagnosis, food, chemical and biochemical reagents, diagnostic products in vitro and other health-						
	related aspects, as well as its regulatory aspects".						
Research and	Resolution 6/2017 describes as disciplines of: "research and development for innovation, production, evaluation,						
development for process	quality control and assurance and regulatory aspects in processes and services of pharmaceutical care and health						
and service innovation	care.						
Management and	Resolution 6/2017 describes as disciplines that includes: "a) projects and processes; b) pharmaceutical business;						
entrepreneurship	c) pharmaceutical assistance and health facilities; (d) pharmaceutical services ".						
I	Activities / disciplines not framed in any of the areas of knowledge above and that meet the simpler definition of						
interuiscipintary	Berger (1972): "interdisciplinarity is an interaction between two or more disciplines".						

Source: Prepared by the Authors

4- **Quantification**: the disciplines were counted per the number of semesters in which they appeared in the curricular program of the courses. This quantification was intended to evaluate the percentage participation of this discipline in relation to the core areas and areas of knowledge required by the new Generalist Pharmacy Curriculum Guide.

3. Results and Discussion

It was analyzed the disciplines of curricular program of 42 universities listed on the Brazilian Federal Pharmacy Council website, as follows:

	Universities	Website
1	UFG - Universidade Federal de Goiás	http://www.farmacia.ufg.br
2	CESUPA - Centro de Ensino Superior do Pará	http://www.cesupa.br/Graduacao/Biologicas/farm.asp
3	UNIARARAS - Faculdade de Ciênicas e Biologia de Araras	http://vestibular.uniararas.br/cursos/?tag=farmacia
4	PUCRS - Pontificia Universidade Católica do R.G. do Sul	http://www.pucrs.br/saude/curso/farmacia/
5	PUCPR - Pontificia Universidade Católica do Paraná	https://www.pucpr.br/escola-de-ciencias-da-vida/graduacao/farmacia/
6	Faculdades Oswaldo Cruz	http://www2.oswaldocruz.br
7	PUCCAMP - Pontificia Universidade Católica de Campinas	https://www.puc-campinas.edu.br/graduacao/farmacia/
8	UFRGS - Universidade Federal do Rio Grande do Sul	http://www.ufrgs.br/ufrgs/inicial
9	UFSC - Universidade Federal de Santa Catarina	http://ufsc.br
10	UFMS - Universidade Federal do Mato Grosso do Sul	https://www.ufms.br
11	UFMT - Universidade Federal do Mato Grosso	http://www.ufmt.br/ufmt/site/
12	UNIMEP - Universidade Metodista de Piracicaba	http://unimep.edu.br
13	UFMG - Universidade Federal de Minas Gerais	https://ufmg.br
14	UFOP - Universidade Federal de Ouro Preto	http://www.ufop.br
15	UFPE - Universidade Federal de Pernambuco	https://www.ufpe.br
16	UFRJ - Universidade Federal do Rio de Janeiro	https://ufrj.br

Table 2. Universities analyzed

17	UCPEL - Universidade Católica de Pelotas	http://www.ucpel.edu.br/portal/
18	UNISANTOS - Universidade Católica de Santos	http://www.unisantos.br
19	UNIFENAS - Universidade de Alfenas	http://www.unifenas.br/index.asp
20	UnB - Universidade de Brasília	http://www.unb.br
21	UNICRUZ - Universidade de Cruz Alta	https://home.unicruz.edu.br
22	UNIC - UNIVERSIDADE DE CUIABÁ	http://www.unic.br/Paginas/Home.aspx
23	UNIMAR - Universidade de Marília	http://www.unimar.br/cursos/graduacao/farmacia/
24	UNAERP - Universidade de Ribeirão Preto	http://www.unaerp.br
25	USF - Universidade São Fransico	http://www.usf.edu.br
26	FCFRP - Faculdade de Ciências Farmacêuticas de Ribeirão Preto	http://fcfrp.usp.br
27	USP - Universidade de São Paulo	http://www5.usp.br
28	UNISUL - Universidade do Sul de Santa Catarina	http://www.unisul.br/wps/portal/home/
29	UNIVALE - Universidade Vale do Rio Doce	https://www.univale.br/PosEaD/
30	UEPB - Universidade Estadual da Paraíba	http://www.uepb.edu.br
31	UEM - Universidade Estadual de Maringa	http://www.uem.br
32	UEL - Universidade Estadual de Londrina	http://www.uel.br/ccs/farmacia/
33	UEPG - Universidade Estadual de Ponta Grossa	http://portal.uepg.br
34	UFBA - Universidade Federal da Bahia	http://www.ims.ufba.br
35	UFP - Universidade Federal do Pará	https://portal.ufpa.br
36	UFPR - Universidade Federal do Paraná	http://www.ufpr.br/portalufpr/
37	UFPI - Universidade Federal do Piauí	http://www.ufpi.br
38	UFF - Universidade Federal Fluminense	http://www.uff.br
39	UNIP - Universidade Paulista	https://www.unip.br/portal.aspx
40	Unifal - Universidade Federal de Alfenas	http://www.unifal-mg.edu.br/portal/
41	UFES - Universidade Federal do Espírito Santo	http://www.ufes.br
42	Centro Universitário Newton Paiva	https://www.newtonpaiva.br

Source: Brazilian Federal Pharmacy Council website (CFF, 2017)

Although there are more than 400 pharmacy courses in Brazil and the present study has considered only the universities listed on the website of the Brazilian Federal Pharmacy Council (CFF, 2017), the majority part of the analyzed universities were well evaluated by the Brazilian government (BRASIL, 2011). Furthermore, as the subject of the study deals with adjustments in the training of the interdisciplinary pharmaceutical professional, entrepreneur and promoter of innovation in products and services, therefore with a strong connection with the regulatory question, it was understood that the sample of the courses explicitly connected with the Federal Council is sufficient for the exploratory study.

The curriculum program of the 42 courses provided 3742 disciplines in total. The analysis of titles and syllabuses of these disciplines, including their use in nVivo® software, led to the coding of 113 "macrodisciplines", which were quantified by the number of semesters that appeared in each course in total. The International Educative Research Foundation and Publisher © 2018 pg. 161 content analysis of the macro-disciplines also allowed its categorization in relation to the core areas of Resolution 6/2017 (Classification I) and areas of knowledge (Classification II) of all the sample content, as follows:

Table 3. Disciplines and its classifications (I and II)

	Macro-disciplines		Classification I:	Classification II:	
	(total of 42 universities)	Amount	Core Areas Resolution 6/2017	Areas of Knowledge	
1	celular and molecular biology	114			
2	microbiology	87			
3	parasitology	80			
4	immunology	79			
5	physiology	61			
6	anatomy	45	Pharmaceutical Technology	Biologic sciences	
7	histology	32			
8	mycology	20			
9	virology	14			
10	bacteriology	11			
11	embryology	10			
12	chemistry	451			
13	physical	42	Dhamma agutiant Tanhu alagu	Exact Sciences	
14	statistics/biostatistics	41	Pharmaceutical recinology		
15	calculus / mathematics	36			
16	publichealth	53			
17	epidemiology	51			
18	comunication	9	Health Care	Health Sciences	
19	medicine administration	3			
20	Neglected deseases	2			
21	hospital pharmacy	36			
22	health policies	12	Health Management	Health Sciences	
23	Health legislation	7			
24	ethic	29	Health Care	Human and Social Sciences	
25	firstaid	12			
26	Psychology & pharmacy	9	Health Care	Interdisciplinary	
27	nutrigenomics	2			
28	Environment and sustainability	17			
29	Economy & pharmacy	9	Health Management	Interdisciplinary	
30	marketing &health	7			
31	bioinformatics	6			
32	Clinical trials	5	Pharmaceutical Innovation	Interdisciplinary	
33	nanotechnology	4			
34	biosafety	21	Pharmaceutical Tasknalow	Interdisciplinery	
35	Laboratory animals	2	i narmaceutear reennoiogy	merdiscipinary	
36	internship	260	Internship	Internship	

37	Graduation work	114			
38	Teaching preparation	15			
39	Pharmaceutical assistance	45	Health Care	Management & Entrepreneurship	
40	management	56	Health Monogoment	Managament & Entrongon averbin	
41	entrepreneurship	8	nearm management	Management & Entrepreneurship	
42	languages	28			
43	History and philosophy	20			
44	Brazilian sign language	19			
45	social sciences	16			
46	economy	7			
47	anthropology	6			
48	forensicscience	4			
49	Study of contemporary man	4			
50	Basic computing	2			
51	cinema	2			
52	cultural activities	2			
53	Occupational safety & health	2			
54	sport	2			
55	acupuncture	1	Not Poloted to Dhormoov	Multidissinlinen	
56	biogeography	1	Not Related to Filalinacy	Mundiscipinary	
57	bodymaintenance	1			
58	demography	1			
59	education of ethnic-racial relations	1			
60	employability	1			
61	epistemology	1			
62	evolution	1			
63	groupdinamic	1			
64	justice	1			
65	logistic	1			
66	music	1			
67	oenology	1			
68	spirituality	1			
69	Theory of knowledge	1			
70	Diagnosis and clinical analysis	44			
71	Clinical pharmacy	26			
72	nutrition	15	Health Care	Pharmaceutical Sciences	
73	semiology	5			
74	pharmacovigilance	3			

75	deontology	36	Health Management	Pharmaceutical Sciences	
76	biochemistry	129			
77	food	112			
78	pharmacology	105			
79	pharmacotechnical	101			
80	toxicology	97			
81	Pharmaceutical technology	90			
82	qualitycontrol	81			
83	hematology / hemotherapy	64			
84	pharmacognosy	56			
85	cosmetics	51			
86	pathology	51			
87	homeopathy	41			
88	botany	35			
89	genetics	34	Pharmaceutical Technology	Pharmaceutical Sciences	
90	bromatology	32			
91	controle de qualidade	32			
92	Introduction to pharmacy	29			
93	herbal medicine / natural products	28			
94	enzymology	15			
95	pharmacodynamics	13			
96	pharmacoeconomics	8			
97	pharmacokinetics	8			
98	radiopharmacy	7			
99	Fermentation technology	6			
100	oncology	6			
101	Domesanitary products	1			
102	nutraceutical	1			
103	Quality assurance	11	Health Management	Process R&D	
104	drug/product development	27	Pharmacoutical Innovation	Draduat P & D	
105	biopharmacy	10			
106	Pharmaceutical production	35			
107	biotechnology	19	Pharmaceutical Technology	Product R&D	
108	pharmacogenomics	4			
109	Pharmaceutical care	47	Health Care	Service R&D	
110	optional disciplines	30	Undefined Content	Undefined Content	
111	Interdisciplinar pharmacy	4		Underined Content	
112	Varied content	140	Additional activities	Additional activities	

113	Student exchange	7	
	Total	3742	

Source: Prepared by the Authors

3.1 Classification I: core areas of Resolution 6/2017

From Table 3, internship and additional activities represent 10% and 4%, respectively, of the total course time (against the 20% and 3% desired by the new curricular guide) as graphically represented below:



gure 1: Total core areas (Classification) Source: Prepared by the Authors

According to the new curriculum guide, the core areas of undergraduate pharmacy courses should be distributed in 50% health care, 40% health technology and innovation and 10% health management, excluding time for internship and additional activities. Analyzing the 42 universities together, 76% of the course is dedicated to health technology and only 2% to innovation, totaling 78% which is 38 points fold above the 40% expected by the new guide:



Figure 2: Total core areas, excluding internship and additional activities (Classification I) Source: Prepared by the Authors

Health care represents 11% and health management 6%, while the new Guide expects 50% and 10%, respectively. Multidisciplinary disciplines from other courses than Pharmacy as well as "undefined content" disciplines represent 5%.

Analyzing each university individually, it is evident the high heterogeneity among universities as demonstrated below:

Universiti es (*)	Additional activities (%)	Health Care (%)	Health Manag. (%)	Internship activity (%)	Not Related to Pharm. (%)	Pharm. Innovation (%)	Pharm. Technol. (%)	Undefined Content (%)	Grand Total (%)
А	0,0	1,5	4,5	13,6	0,0	0,0	80,3	0,0	100,0
AA	4,3	20,0	5,2	7,8	1,7	1,7	58,3	0,9	100,0
В	14,3	21,4	7,1	14,3	1,8	0,0	41,1	0,0	100,0
BB	5,0	12,1	9,3	5,7	1,4	2,1	64,3	0,0	100,0
С	1,5	9,1	4,5	18,2	1,5	0,0	65,2	0,0	100,0
CC	2,8	11,3	5,6	11,3	1,4	0,0	66,2	1,4	100,0
D	4,2	16,9	9,9	18,3	1,4	5,6	43,7	0,0	100,0
DD	7,5	13,4	3,0	16,4	7,5	0,0	49,3	3,0	100,0
Е	0,0	10,7	8,9	10,7	0,0	0,0	69,6	0,0	100,0
EE	3,4	9,2	5,7	10,3	4,6	0,0	62,1	4,6	100,0
F	0,0	8,0	6,0	2,0	2,0	4,0	78,0	0,0	100,0
FF	1,3	9,1	3,9	14,3	5,2	0,0	66,2	0,0	100,0
G	5,6	8,5	2,8	15,5	7,0	0,0	60,6	0,0	100,0
GG	11,1	4,2	8,3	11,1	2,8	0,0	61,1	1,4	100,0
Н	13,3	5,3	6,7	16,0	4,0	0,0	52,0	2,7	100,0
HH	4,5	6,1	4,5	15,2	3,0	0,0	66,7	0,0	100,0
Ι	3,1	7,7	4,6	6,2	1,5	3,1	72,3	1,5	100,0
J	11,2	3,0	4,5	11,2	18,7	1,5	47,8	2,2	100,0
JJ	0,0	11,8	2,9	20,6	2,9	0,0	61,8	0,0	100,0
К	0,0	8,5	4,3	14,9	0,0	1,1	70,2	1,1	100,0
L	1,3	9,0	3,8	11,5	2,6	1,3	65,4	5,1	100,0
LL	4,0	9,3	4,0	13,3	2,7	1,3	60,0	5,3	100,0
М	6,3	4,2	4,2	14,6	2,1	0,0	68,8	0,0	100,0
MM	10,0	6,3	5,0	7,5	3,8	2,5	65,0	0,0	100,0
N	0,0	3,9	9,1	10,4	0,0	0,0	71,4	5,2	100,0
NN	8,5	20,3	6,8	15,3	6,8	0,0	42,4	0,0	100,0
0	1,7	8,6	8,6	7,8	6,0	1,7	65,5	0,0	100,0

Table 3. Universities core areas (Classification I)

www.ijier.net

Р	10,0	7,1	5,3	8,8	2,9	1,2	64,7	0,0	100,0
РР	6,1	10,6	4,5	13,6	1,5	0,0	62,1	1,5	100,0
Q	6,6	14,4	3,0	12,0	9,0	0,6	54,5	0,0	100,0
QQ	5,6	8,3	9,7	8,3	0,0	0,0	66,7	1,4	100,0
R	1,0	7,0	4,0	9,0	3,0	2,0	74,0	0,0	100,0
RR	0,0	7,7	7,7	10,6	1,0	1,9	71,2	0,0	100,0
S	0,0	5,0	5,0	11,7	0,0	0,0	78,3	0,0	100,0
SS	0,9	13,8	4,3	1,7	0,9	6,9	71,6	0,0	100,0
Т	1,9	6,7	4,8	10,5	4,8	1,0	70,5	0,0	100,0
U	0,0	9,6	5,5	13,7	5,5	0,0	64,4	1,4	100,0
V	0,0	9,1	2,7	8,2	3,6	2,7	73,6	0,0	100,0
W	2,2	8,0	4,3	8,7	1,4	2,2	73,2	0,0	100,0
Х	0,0	5,7	5,7	11,5	4,6	1,1	71,3	0,0	100,0
Y	0,0	7,1	7,1	10,7	0,0	0,0	71,4	3,6	100,0
Z	2,2	12,5	2,7	2,2	1,8	3,1	75,4	0,0	100,0
Grand Total	3,9	9,5	5,3	10,4	3,4	1,4	65,1	0,9	100,0

(*) Use of codes for ethic reasons

Source: Prepared by the Authors

Regarding internships, only the **JJ** University would meet the 20% new criterion. All other universities analyzed would have to increase the time of curricular internship. On the other hand, 19 of the 42 universities must reduce the time of "additional activities" to reach 3%.

For disciplines classified as "health care", where the new Guide expects 50%, the value has a minimum of 1.8% for university **A** and a maximum of 30% for university **B**. For the disciplines classified as "health management", which is expected to be 10%, there is a minimum value of 2.8% for university **Z** and a maximum of 12.7% for university **D**. For disciplines classified as "health innovation", there is a minimum value of 0% for 21 of the 42 universities analyzed and a maximum of 7.3% for university **D**.

In relation to the disciplines classified as "health technology", where the new Guide expects 40%, a minimum value of 55.6% is found for NN university and a maximum of 93.0% for university A.

The results demonstrated graphically below confirm that the analyzed universities are quite different from each other in relation to the "health care" and "health management" core areas (which should be more expressive to reach 50% and 10% of the curriculum Guide, respectively), while there is inexpressiveness in innovation, which is considered together with health technology by the new Guide:



Figure 3: Universities and core areas

It is verified, therefore, that significant adjustments must be made by the Brazilian universities to reach the proportionality required by the new curriculum Guide. As innovation is being considered together with "health technology", there is great risk the decreasing of this core area to 40% can stifle even more the prevalence or even the creation of new disciplines that support innovative process, products and/or services by future pharmacists.

It must be considered whether the offer of "multidisciplinary" / non-pharmacy related disciplines (such as music, demography, history, cinema, etc.) as well as those of "undefined content" should be offered to pharmacy students, even though they occupy only 5% of the total course time.

Universities must rethink their curriculum qualitatively and not only quantitatively when planning the new programs. Otherwise, the proportionality of 50/40/10 required by the new curricular Guide within just 2 years can lead to a simply re-allocation of disciplines, keeping the history of a immature, disjointed curriculum that does not stimulate innovation and does not correlate contents (SOUSA, BASTOS, 2016).

This correlationship can be evidenced by interdisciplinary practices, whose analysis is presented below.

3.2 Classification II: Areas of knowledge

Analysis related to innovation, entrepreneurship and interdisciplinarity.

As shown in Table 1 of the Methodology section, the areas of knowledge of the universe sampled were mapped, giving the following results:



Figure 4: Areas of knowledge with emphasis on Pharmaceutical Sciences

According to a new curriculum Guide, contents in pharmaceutical sciences, except for the internship, must correspond to at least 50% of the course hours. The overall result of all universities together amounts 42.5%, where only 1 university would attend to the new Guide. Increasing biomedical disciplines to meet the new Guide, without considering disciplines or even disciplinary interactions through interdisciplinary practices, can only reinforce the existing problematic. According to Jungnickel (2009), the curriculums usually masses with biomedical disciplines as a way to add more content, while the curriculum of the future should promote the development of transversal competences through interdisciplinary practices: professionalism, self-directed learning, leadership and advocacy, interprofessional collaboration, cultural competence, innovation and entrepreneurship (MEIJERMAN, 2013).

Evaluating the interdisciplinarity and entrepreneurship, there is little expression in the total sample of 3742 disciplines, as shown below:

HEALTH CARE	HEALTH MANAGEMENT	PHARMACEUTICAL	PHARMACEUTICAL	
		INNOVATION	TECHNOLOGY	
Management and	Management and	Droduct D & D	Droduat D & D	
Entrepreneurship	Entrepreneurship		Product K&D	
	Entrepreneurship (8)	Biopharmacy (10)	Biotechnology (19)	
Pharmaceutical assistance (45)	Management (56)	Drug/product development (27)	Pharmaceutical production (35)	
		Pharmacogenomics (4)	Pharmacogenomics (4)	
Interdisciplinary	Interdisciplinary	Interdisciplinary	Interdisciplinary	
First aid (12)	Economy & Pharmacy (9)	Bioinformatics(6)	Dissofate (21)	
Nutrigenomics (2)	Environment and sustainability (17)	Clinicaltrials (5)	Biosafety (21)	
Psychology & pharmacy (9)	Marketing & Health (7)	Nanotechnology (4)	Laboratoryanimais (2)	
Service R&D	Process R&D			
Pharmaceutical care (47)	Quality assurance (11)			

Table 4: Core areas x areas of knowledge (Classification II)

Source: Prepared by the Authors

In many countries, it is common for pharmacy courses do not offer, for example, disciplines related to drug discovery, drug development, regulation and registration, which knowledge is so important to the pharmacist (MEIJERMAN, 2013; SMITH, 2002). The present data show that, in addition to these disciplines sparkly offered, it was not possible to identify any other discipline or practice that evidences connection or interaction of contents to stimulate the innovation of pharmaceutical products, practices or services in Brazilian universities. Innovation emerges from practices that stimulate creative thinking to visualize better ways to achieve goals and walks along with the entrepreneurial spirit that, in its intended connotations to the pharmaceutical professional, includes such elements as uniqueness, adaptability, potential development, and the creation of new opportunities (LAVERTY, 2015, TURNER, 2018).

This challenge has already been experienced by universities in developed countries such as Netherlands and United States, which have included new educational methods in their curriculum through active learning composed of project-based and problems disciplines. Students were encouraged by a multidisciplinary team of teachers to generate products (reports, protocols, posters, presentations, planning, etc.) related to each stage of drug development from drug discovery, patents, preclinical trials, until led the product to the market. Thanks to combining disciplines from several areas of knowledge of the course, students were encouraged to develop other behavior skills by interaction with industry, practice of scientific research and communication, exercise of leadership, management, self-development and entrepreneurial spirit (MEIJERMAN, 2013, POLOYAC, 2017).

From a first quantitative perspective and in order to comply with the new curriculum Guide (Resolution 6/2017), Brazilian universities will need to increase their hours of pharmaceutical sciences, internship, and disciplines related to core areas of health care, management, innovation and entrepreneurship while, at the same time, they should reduce the disciplines related to health technology. This challenge can be overcome by interdisciplinary strategy as an effective qualitative solution to promote product or service innovation in upcoming pharmaceutical new programs, instead of adding isolated disciplines.

4. Conclusion

Innovation through pharmaceutical products and services is as important for the health of the population as it is for a country's economy, especially Brazil, considered the 6th largest market for pharmaceutical products in the world. Among many national strategies to address the vulnerability of the country to imported technologies, it is the training of the pharmacist one of the key players in the innovation process. In 2017 Generalist Pharmacy Curriculum Guide (Resolution 6/2017) was published, which includes innovation, entrepreneurship and interdisciplinarity for the first time as components of the Brazilian undergraduate pharmacist training.

This innovative study has achieved the proposed objectives by analysis of how current curriculum programs face these political, economic and academic challenges. Results of 42 Brazilian undergraduate pharmacist courses showed very heterogeneous curriculums but convergent patterns regarding the need to make

significant adjustments to comply with Resolution 6/2017. The 3742 disciplines evaluated by content analysis procedure, supported by NVivo® software, have generated 113 categories of disciplines, distributed in 8 core areas and 9 areas of knowledge. The result showed there is insufficiency related to health care and health management core areas as well as hours of internship, while there is predominance of health technology (>75%) with only 2% of innovation besides inexpressive presence of entrepreneurship and interdisciplinarity in the curriculums.

Considering the deadline for such substantial adjustments is only 2 years, Brazilian universities should rethink their teaching model in order to accomodate the Resolution 6/2017 requirements without overload the already extensive courses. Otherwise, disconnection and isolation of disciplines can remains. Therefore, the interdisciplinarity, so necessary for innovation, must be evidenced through disciplines and / or activities that generate a connection of knowledge and that stimulate the entrepreneurial and leadership behaviors for the new pharmacist. Cooperation-based teaching models / partnerships with other sectors, as well as projects and problem solving, should be effective strategies to be considered by universities to meet these current challenges.

Suggestion of future studies include the specific mapping of disciplines that would meet the society needs and Product Development Partnerships promoted by the Brazilian government.

In summary, this is an opportunity for Brazil to build a new trajectory in the training of the pharmacist in order to meet the economic and social needs of the country, which should not be just a consumer market, but also a sustainable knowledge promoter.

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Teachers multidimensional role towards meaningful learning: the potential value of interdisciplinary environments

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Abstract

The definition of "interdisciplinary learning environment" gives rise to different interpretations. This article presents and discusses interdisciplinarity in pedagogical practice for the construction of meaningful learning, strengthening the construction of knowledge in personal, scientific and social spheres. Case studies respectively show: the contribution of interdisciplinary work to self-identity and subjective constitution in early childhood; interdisciplinary work in an informal learning environment as a facilitating element towards scientific knowledge consolidation; and the university's interdisciplinary work in social projects for building a fairer society. In the light of neuroscience, the article discusses aspects of cognitive and social-emotional developments, as well as the approximations and estrangements between the object of study and the epistemic subject. In the so-called Society of Information, the multidimensional character of the teacher's work becomes a necessity and a challenge, since it is the school's role to form citizen-students, developing competences to increase students' academic knowledge and extend it to their personal, professional and social lives.

Keywords: meaningful learning; interdisciplinary learning environment; competence development.

1. Introduction

The definition of "interdisciplinary learning environment" gives rise to different interpretations. Learning is a continuous and lifelong process, concerning different people, different ages and into the most different contexts: familiar, academic, institutional, business and social. This article discusses interdisciplinarity in pedagogical practice, which along with well-defined educational objectives, tends to favour learning situations and promote student protagonism, systematic curiosity, encouragement to research and reconstructive questioning.

Museums are examples of interdisciplinary learning environments, which allow teachers integrative pedagogical approaches and allow students to make connections across disciplines. The National Archeology Museum, in France, is a well-known example of how an archeological collection of more than 30.000 exhibits can be presented in a contextualized and relevant way. Says the museum about its Neolithic objects collection: "*The Neolithic (dating from 5800 to 2100 B.C.) is prehistory's second period. Back then, populations became sedentary due to the emergence of agriculture and livestock. The first villages are built*

and the first megalithic structures are erected. This period is characterized by technical innovations, such as stone polishing, the emergence of ceramic and weaving." It is noticeable that, beyond the given collection, the visitor is led to ponder on the archeological collection under the perspective of different disciplines, such as: history, geography, biology, chemistry and physics.

In fact, school content is divided into disciplines to enable systematized and effective teaching. Beyond school's walls, museums, libraries, parks and expositions are opportunities to rescue, reinforce and articulate contents in an interdisciplinary fashion, making them relevant and interesting, maximizing the student's engagement in the knowledge construction process. In the 21st century, teacher training covers complex and multidimensional aspects: beyond the mandatory curricular content, protagonism is expected from the teacher, along with authorship that fosters, above all, meaningful learning.

2. Meaningful learning: continuous connections with previously known knowledge

The concept of Meaningful Learning started with David Ausubel's classic theory, specially his work "The acquisition and retention of knowledge: a cognitive view" [1]. Although dated and, according to some, surpassed, his theory lingers on and does require teacher's attention.

Meaningful Learning has as a main characteristic the interaction between previous knowledges and new knowledges. In a nutshell, meaningful learning is a process whereby symbolic expressed ideas interact in a meaningful fashion with student's previous experiences, allowing them to redefine and enlarge their knowledge. Previous experience is an anchoring idea or subsumer (specific knowledge already existent in student's cognitive structure). People learn from what they already know: meanings expand and get transformed, providing significance to new understandings. Evidently, there are conditions for this learning to occur: learning material must be potentially meaningful (logical, relevant) and the student must be willing to learn.

The teacher has the task of knowing not only what and how to teach, but mainly, to whom he is teaching and how that person learns. It is common within school's context, to require proofs whether the student "knows or does not know", that they are "right or wrong", that the answer is "yes or no". So, student is expected to provide "right answers", even though the subject in discussion is not yet understood. When teaching or grading, one must consider comprehension, meaning uptake, and, mainly, the capacity to transpose those knowledges to new situations, applying them into different contexts. It is important to allow the student to redo their learning activities, if wished or needed, minding that they explain , justify the given answers, showing true meaningful learning and not just a copy or simulation of a knowledge which they do not have.

The meaningful learning depends on new postures, new looks to different types of learning and, mostly, distinct ways to evaluate. From three case studies, this article presents and discusses interdisciplinarity in teaching practice to the construction of a meaningful learning, favoring the construction of knowledge in personal, scientific and social spheres.

2. Case studies: strategies for effective teaching and meaningful learning

2.1 The protagonist teacher and his contributions to the construction of subjectivity in early childhood

Early childhood is an important phase on the development of the child and the teacher is a fundamental part of it. Teachers must reevaluate themselves, understand others, notice the interdependence and interactions necessary for the job, the conviviality. Teachers have powers that emerge from their place and from themselves; the teacher's role is not simply to teach school content, as mentioned by Alicia Fernandez [2]. The teacher needs, before the technique, "to look" upon the student, "to listen", through any sense, or better yet, through all of them. The teacher needs to learn from the student before teaching him or her. The teacher in early childhood, expert or not, must be prepared to provide a creative process of learning, not a corrective one. Learning must be meaningful, captivating, planned and loving. Teamwork is important, and the complicity must occur between educational colleagues as well as among students, always aiming the education and overall development of this new person. The following case describes straightforwardly the importance of respect and the child's "beliefs", providing trust and the power to overcome difficulties.

Magali, struggling to express herself and filled with aggressiveness, started school when she was two years old, without talking, just making isolated sounds. The school staff got involved on the observation work to assess if her "problem" was cognitive or emotional, trying to overcome the unsettling speak blockage. The staff, composed of educational psychologists, psycomotricians, psychoanalysts, music teachers, dance teachers, art teachers, yoga teachers, capoeira teachers, foreign languages teachers, pushed themselves to motivate her towards communication, starting by forming good emotional bond. The goal was to develop her speech, without harming her self-esteem, so no damage would be inflicted on the construction of her self-concept. She was treated with confidence during classes and with equality among her friends. Her silence was not considered. Magali starts to do well in her foreign language classes. She realizes that her friends did not know how to speak this new language either; there they were also silent. This finding made her inhibition cease. She feels very comfortable and starts talking, feeling socially equal, well accepted and accepting others. Using her interest, the teacher starts to address contents from other areas. The foreign language was the trigger to unlock a possible "learning difficulty" and ends up achieving a better use for the group, and mainly to Magali because one language enriches the other and Magali finds in this encounter an opening to express herself, understanding the pleasure of putting herself out there and starting to speak, also in her native language. Her aggressiveness diminishes and her satisfaction towards her achievements is clear.

As children see themselves through adult's eyes, the teacher must go beyond formal fashion or find meaning in it, so the student can search and they can find solutions together. In this partnership, the way out, of what was before, a possible "learning difficulty", was the social acceptance, which although not real or clear, made sense to Magali. The "Meaningful" in Magali's case was her sensation of failure possibly triggered by some already overcame motor difficulty which could have been resignified through her success in foreign language; a new beginning.

2.2 Teaching through research and its contributions for scientific knowledge construction

Museums, parks and libraries are learning environments which allow an interdisciplinary experience of the

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school's content. This case study reports the initiative of the Nuclear Sciences Museum to offer it teachers and students a deeper understanding on nuclear energy and its pacific applications. According to the Brazilian Guidelines and Bases to National Education Law [3] and the National Curriculum Guidelines to Basic Education [4], it is school's responsibility to provide the students a minimum curriculum, enabling the development of abilities and skills that lead to a fair comprehension on nuclear reactions and its applications. The teacher is expected to develop students' critical thinking, instigating deeper researches and discussion of real questions about nuclear technology [5]. However, nuclear science is still a controversial theme among a significant portion of the Brazilian population. Most often, even teachers are aware of the issue and the subject is explored in a superficial level, so that the minimum curriculum is attended. Considering nuclear technology's correlation to important aspects of everyday life (food safety, agriculture, nuclear medicine and industrial applications), how to help teachers to reach more accurately the National Curriculum Guidelines' goals?

The main goal of the Nuclear Sciences Museum is to communicate the peaceful applications of nuclear technology, demystifying paradigms, questioning unjustified prejudices and fostering the elaboration of critical thinking on daily issues related to nuclear sciences. The museum's collection includes objects, interactive panels, videos, photographs and models. The space offers guided visit, practical experiences and multimedia activities, which allows the visitors to deepen their knowledge and resignify the offered information. On occasion of the National Museum's Week, in 2016, tens of museums from all around the country fostered a variety of activities on the theme "Cultural Landscapes". During the week, the museum offered the academic public an opportunity to unravel "The radiation's secrets behind the most beautiful cultural landscapes". Doing this, through lectures and interactive activities, teachers and students from elementary and high school were led to know: France and nuclear power production; England and nuclear techniques for unraveling the secrets of mummies and sarcophagi; Egypt and the use of carbon-14 for archeological findings dating; United States of America and natural radioactivity; Bolivia and cosmic radiation; Italy and x-ray techniques for authentication and recognition of artworks. Yet, since it was a Brazilian audience, beautiful national tourist destinations that raise interesting reflections about nuclear energy were selected, such as: Guarapari, with its monazitic sands; Poços de Caldas, with its radioactive anomalies and Rio de Janeiro, the only Brazilian state to produce nuclear energy. This is one of many actions promoted by the Museum of Nuclear Sciences.

Every year, the museum participates on different thematic cultural weeks, presenting nuclear sciences through several points of view, articulating science with visitors' past experiences, promoting contextualized knowledge, making science meaningful and relevant. In a playful and apparently informal manner, a visit to the Museum of Nuclear Sciences offers a deeper learning of nuclear physics with an interdisciplinary approach; articulating Physics, Chemistry, Geography, History, Biology and Math. Each educational solution is developed to combine scientific knowledge with meaningful experiences which young people are dealing with, problematizing questions that instigate their curiosity. It is expected from this action that educators may know new dimensions of nuclear physics, enlarging the discussions in the classroom. In order to improve the communication actions, the museum invites visitors to rate their experience at the Nuclear Science Museum on a 10-point scale, where 10 means a very good experience.

In year 2016, among 1.442 responders, 88,6% of the visitors, rated 9 to 10, proving the high quality experience in learning nuclear science at the museum.

This experience reports the contribution of a non-formal space of learning to the improvement and modernization of science teaching, giving the teachers tools to complement schools content, favouring scientific literacy. According to UNESCO (2013), scientific literacy assumes the development of specific abilities and skills, such as the student's capacity of searching for information, his or her critical consciousness to analyze them, his or her questioning disposition and knowledge (re)construction [6]. It is the school's role to form citizen-students, able to extend their knowledge beyond academic sphere, able to actively participate on our society's decision making processes [6]. Scientific literacy is possible and needed since early childhood and it is the educator's role to foster learning situations that favors the transposition of merely didactic contents into everyday life applicable knowledge [7 - 8].

2.3 The teacher as a cultural mediator and his contributions to the construction of a fairer society

We understand that one of the teacher's role in modern society is to stimulate meaningful learning situations among young people. The sense of duty and justice must be the educator's ongoing commitment for the construction of a better society. The purpose of teaching work must favor the dimension of "preparing young people to elevate themselves into the level of present time's civilization – its richness and its problems – so they can act", including scientific, technical and, also, social preparation to do such [9].

Education in formal environments, throughout historical process, reinforces the traditional culture of teaching and learning. Non-formal environments, however, attest the relevance of assuming the pedagogycal practice in different learning spaces, as a way to effectively understand the problems of current society [7]. In this context, meaningful mediations from teachers, in centers beyond school walls, become relevant, as they provide tools moving students towards a more equal society. The Federative Republic of Brazil's 1988 constitution postulates in its 5th Article that "everyone is equal before the law, with no distinction of any kind, granting Brazilian people and foreigners living in the country the inviolability of the right to live, to freedom, to equality, to security and to property, in the following terms" [10]. Therefore, children, young people and adults, in a social vulnerability situation, must benefit from social actions, implemented by adults committed to the construction and development of a fairer society.

We will describe some of the projects developed by young college pedagogy students from a private university in the city of São Paulo, Brazil. The projects were designed by students from the third semester, in a discipline called "Projects Elaboration and Analysis". Based on the discipline's demands, these college students, searched for non-formal spaces to apply their ideas. The teacher conducted learning situations, involving, motivating, and questioning the students in order to stimulate investigative possibilities. In this relationship, teacher and students co-construct knowledge together, distancing themselves from the traditional model, in with the teacher owns the knowledge, transmiting it through methodologies and contents, in many cases disconnected from student's reality.

The projects "Beethoven", developed through classical music, and "A mouth like a ten"², based on the importance of hygiene and oral health, were developed in children's and teenagers' foster home before or

² Original name in Portuguese : Projeto Boca Nota 10

after school's regular time. The "Brilliant talents"³ project, managed through artistic activities, was conducted in a support home for children with cancer, in the central region of São Paulo (Southern Brazil), where they receive and accommodate children and teenagers from many other Brazilian states.

The "Beethoven" project arose from the premise that music activates brain areas, enabling the development of attention, concentration, memory and expression. Shortly, the project conductors sought to broaden these abilities through classical music among children from seven to ten years old. The activities took place in three distinct moments: a) awareness about the importance of music in life; b) practical activities with classical music and feeling externalization through drawings; c) conversation sessions on the activities developed as a form of verbal expression. The study verified that children, when exposed to classical music with defined purposes, became more serene, alert, concentrated on the activities being developed and easily expressing their feelings, through drawings or during the conversation sessions.

The "Brilliant talents" project used art during the activities conduction through the manipulation of play dough. Children, between four and five years old, initially manipulated the material as a way to recognize what they had in their hands. After the initial handling of the material and with the student researcher's support, they started to model different elements as: houses, parents, brothers, indicating, through an informal conversation with the student researchers, that they missed what was left behind because of the distance. Children, in a second moment, through intervention of the project developers, began to express other feelings, modeling the play dough and experimenting with dough mixtures transformed into new colors. This moment enabled the children to relive a "spontaneous way of playing" through a symbolic game. In addition to it, they were able to work up their touch, smell and vision, develop fine motor skills and concentration, and also socializing their productions with other children. The work, in its two moments, allowed them to externalize their feelings through the modeled elements. The advisor teacher's mediation was precise so the students, the project developers, could understand: (a) the work format to be developed with the sick children; and, (b) the channeling of necessary interventions.

Another project developed by the students of the same discipline was channeled with the premise that the situation of oral health in Brazilian society, although its progress over the last decades, still has a challenging configuration, especially when it comes to the underprivileged population. Brazilian social and economic scenario clarifies the following question: we suffer from a bad distribution of wealth, illiteracy, mostly in the northeast region of the country, poor levels of education, homelessness and, in many cases, precarious housing conditions. These conditions have an impact in our population's health. The "A Mouth Like a 10" project sought to raise awareness in children, from six to nine years old, about the importance of oral hygiene and health. The developers sought to consolidate the project by the following instruments: (a) an initial conversation session approaching the importance of oral hygiene; and (b) conduction of the steps for a good brushing. Both instruments, counted with playful elements as a way to approach the subject. The students, when asked to present the discussion of the project's results, concluded that they had not resolved the problem, but started a process of awareness in the target population, accomplishing, in this manner, the founding purposes of the project.

The above-described projects confirm that, during the process of teaching formation, it is fundamental to

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³ Original name in Portuguese : Projeto Talentos brilhantes

focus on the understanding of people's lives under real perspectives. In addition, these experiences proved that when well guided, they boost knowledge and amplify student's eyes around the object of study.

3. Results and discussion: cognitive and socioemotional development aspects

Playing is the beginning of "doing" for human beings. Playfulness is the pleasure in "doing". These experiences of "doing" are learning. Learning is a vivid process every time new information generates change in central nervous system (CNS). Receiving all kinds of information from the organism's exterior and interior, the brain constructs the man. We learn what is necessary to survive and what gives us pleasure. The brain has a rewards' circuit in its limbic system, which has other structures that trigger emotions and a variety of reactions throughout the body in it. When attention fuses itself with emotion a memory is created, learning is this acquisition. The quality of the experience is what defines the registered intensity. Stimuli and experiences are stored in different parts of the CNS and, when evoked, they fuse recreating input in a responsive way (output). New meanings construct themselves through the interaction with previous knowledge. The Brain is plastic, the experiences are important and they construct, by different ways, the learning process of every one of us. The different forms to interact and to experience lead us to learning and make us unique.

Emotions motivate us, make us more vigilant and have a strong influence on the consolidation of memories, favouring the learning process, but may have an opposite effect if they generate too much anxiety or stress. Stressful situations may destroy hippocampus neurons when secreting glucocorticoid hormones from the suprarenal gland. Hippocrates would say that we feel sadness or happiness through the brain. Therefore, by favouring meaningful and pleasant stimuli, humorous, enthusiastic and curious, we end up generating an easier and lasting learning. Activating emotion, attention and memory.

"Learning" usually makes us think of "teacher", but it could happen, and it happens, through many ways or agents, it goes beyond the "formal teaching situation" or even the virtual environments of distance teaching. "Teacher" makes us think of a "formal content, didactic" but there is a lot more to learn and teach. May a teacher lead his or her student to pleasure by seeking self-knowledge, self-sufficiency personal skills and relational abilities, beyond cognitive and productive ones? Yes, first they would have to be so that later they would have, or obtain information.

To involve more than one sense in the experience, reading out loud, declaiming or singing, for instance, is efficient, but the mediator must assess the individual or group in the search for the adequate type of reality they are inserted to signify and anchor the necessary information for a satisfactory acquisition. Allowing him or her to construct and insert him or herself in the world, producing and using the acquired resources with autonomy, seeing the value of the learning process, signifying it in his or her own reality. The "meaning" is in each one. To feel, to see, to hear, to touch, to use all senses, to take control of sensations, reflections and perceptions to understand the students universe makes the teacher a partner, seeking for alternatives together, academically speaking or not. The interaction shows itself as a fundamental part in the search of a solidary and much more meaningful education. The bigger the number of strategies and stimuli used, the bigger the possibility that the content will reach long-term memory; that it will find relational material, previous knowledge.

During the learning process' development and its difficulties, action areas as psychomotricity and neurolearning abide and use cerebral development stages, favouring the dialog between student and teacher, also using resources as Capoeira, Yoga, dancing, Circus, swimming, horseback riding and many more to provide content absorption, ability expansion, adoption of meaningful behaviors. Cognitive training programs as PEI (Ruven Fuerstein's Instrumental Enrichment Program) which seeks to develop the student's adaptation capacity through cognitive strategies and skills with mediated systematic training or the Mathew Lipman's philosophy program for children that focuses on the processes of self-reflection with autonomous and critical thinking also demonstrates that there are other ways the teacher and student can get involved in the learning process using cerebral resources. The IMBE "International Mind, brain and education Society" links scientists, physicians, educators and other education professionals. One of the main objectives of the Society is to foment the trade of information, researches, theories or interdisciplinary and intercultural dynamic practices, among neuroscience, genetics, cognitive science, development and education.

The museum, the cinema, the beach, the computer, parents, friends, are all sources of interaction and learning. But, should we thicken the homeschooling adepts' ranks? Or should we value socialization and the professional who prepares him or herself in a multidimensional manner to insert the subject into the world? For educating is this, is it not? Living is a great learning process. From the first cry to the last breath our brain is willing to learn. Although the rhythm diminishes over the years, the learning process never ends; it is our job to make it meaningful.

5. Final considerations: promoting learning process in different contexts

Teaching, over the years, has become more complex since the Traditional Teaching Approach's principles are renounced, and in their place it is adopted the horizontality of the teacher-student relationship for knowledge composition. The multidimensional character of the teacher's work has become indispensable for a global society, considering the necessity of orientations regarding social sustainability. The cases addressed in this article showed their relevance to the understanding of an individual identity construction, in science appropriation and social dimension, enabling the approximation between educational and social dimensions. In other words, they favour the comprehension of the social world from each subject's singularity.

We have highlighted, throughout the presented case studies, the importance of adopting active methodologies for subject's emancipation in many contexts. These methodologies glimpse a universe of challenges to be overcome, from topic researching, evaluation, to decision making related to risks taken according to the choices that are made. Furthermore, these methodologies stimulate proactivity, autonomy and self-management, which are necessary skills in our lives.

We have also emphasized the importance of the teacher's mediation, from the early childhood to college education: the students, their hypothesis and perceptions should be inside the teacher's attribution range, to question them and their possible conjectures, help them think under yet not contemplated perspectives in such a way that intellectual, emotional and personal skills are awakened. Soon, the works will, when

well guided by experienced and committed teacher, boost knowledge in multiple dimensions. This allow us to affirm that providing and mediating meaningful learning situations from early childhood to adult stage, as the ones described in this study, has become imperative to subjects' emancipation, when considering them in their own particular singularities.

We consider that in a "society for everyone" there is no more space for actions conducted in a traditional way, suppressing the voice of the students and neglecting the needs of its citizens. The "school", as an institution, and the education professionals must open themselves to new methodological appropriations. This article demonstrate the importance of these new methodological appropriations, as a tangible possibility that gives opportunity to effective meaningful learning experiences.

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Entertainment Games for Teaching English as a Second Language:

Characteristics and Potential

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Abstract

This article explores the use of entertainment games for teaching English as a second language. It is a narrative literature review of theories of motivation and learning. To facilitate the choice of didactic resources to be used in the English classroom by teachers, this study brings to light the characteristics relevant to teaching that can be found in games, associated with different genres. In this sense, 14 researches involving digital games of entertainment were analyzed, using as basis Gardner's theories of motivation in the teaching, games and the active learner of Gee, zone of proximal development of Vygotsky, tangential learning model of Portnow and Brown, model of the monitor, Krashen's input hypothesis, Schumann's acculturation model, and the hypothesis of the interaction proposed by several authors such as Gass and Larsen-Freeman and Long. The results obtained were the definition of the relevant characteristics to teaching and learning in games and the identification of the genres associated to these characteristics. The discussion used the following characteristics found in the analyzed texts: motivation, classroom interaction, social interaction in the game, tangential learning, grades, complementary material, vocabulary, repetitive written content, big written content, need for text interpretation, audio and text.

Keywords: games; learning; English; ESL

1. Introduction

This article presents a narrative literature review to identify characteristics and potential of entertainment games for teaching English as a second language.

For the literature search, Google Scholar and Brazilian Portal of Periodicals Capes were used as databases. The general search criteria was: the teaching of English (as a second language) with the use / aid of digital games (or games) aimed at entertainment. The following keywords were used:

allintitle: English game OR games –"english game" –"english games" L2 OR "foreign language" OR ESL OR "second language".

tudonotitulo: Inglês OR "língua inglesa" game OR jogo OR jogos OR games OR MMORPG OR RPG.

The exclusion criteria used were: non-digital games (since the interest of the research is about video games), creation of games (since the interest of the research is about existing entertainment games) and only empirical works (since the interest of the research is empirical work).

As a result of the search and the application of the filters, 14 texts were chosen for review. For each text, a brief summary was written, especially highlighting its target audience, the games used, the methodology, and the results. These summaries were then compared, resulting in the following categories, present in several of them or that deserved attention: students' motivation, learning improvement, students' fear, and teachers' difficulties, besides some peculiarities.

The relevant data of each analyzed text, such as number of participants, game used, and observed game effects in the learning were then crossed, trying to identify which characteristics of the games obtain the best results when used in teaching, which games genres are most suitable for teaching, and the universe where the game takes place (futuristic / fantastic / medieval / etc.).

These results were also analyzed from the perspective of the theories discussed in the next section and the various types of game genres.

The next section presents the theoretical framework used in the analysis. The following section summarizes the reviewed articles. The discussion identifies categories in the analysis of the texts. Finally, the conclusion points to future works.

2. Theoretical framework

This section presents theories that will be used to analyze the results of the literature review. These theories were chosen for their contribution to the analysis of the results of experiments that applied entertainment games to the teaching of languages.

2.1 Motivation in teaching

For Gardner (1985), motivation involves four aspects: a goal, effortful behavior, a desire to reach the goal, and favorable attitudes toward the activity in question. A motivated person would exhibit three main characteristics: attitudes related to motivation, goal-directed behavior, and a kind of integrative motivation.

Brown (2007) and Ryan and Deci (2000) separate motivation into two types. Extrinsic motivation, on the one hand, would come from someone else and target future earnings, which could be money, prizes, grades, and even a positive response. Intrinsic motivation, on the other hand, would involve no reward except the activity itself. Jobs that are intrinsically motivating are those that bring a sense of competence, self-determination, pleasure, and interest. Thus, learners who develop a task that is fun, interesting, and challenging would work harder than those aiming at a reward.

2.2 Games and the active learner

For Gee (2003, 2008), one of the reasons why games are appropriate teaching tools is that they let players take risks, but in a way that the consequences are lower than in real life, as there are ways of saving the game and going back when someone makes a mistake, or even lessen the difficulty of some stage so that initially it is not so complex. There is a low cost associated with failure and a high reward for winning something in games which do not annoy or frustrate players, while constantly provoking them with new challenges so they continue to want to play. This is not to say that players do not care about failures; they matter, but the game does not have a weight in real life, such as school grades.

Gee (2008) believes that digital entertainment games are great teachers, comparing their functioning with the working of the mind. He explains that the human mind works based on experiences, which must contain certain conditions to produce effective for learning. Five properties are mentioned:

- a) experiences must be structured from goals;
- b) the experiences must be interpreted, that is, reflection is needed (in action and after action) on how the goal relates to our thinking in the situation, and to extract lessons learned and anticipate why and when they may be useful;
- c) people learn best if they have an immediate response to their success or failures so they can recognize their mistakes; it is also important that they be encouraged to explain their mistakes and tell what they might have done differently;
- d) learners need opportunities to apply their past experiences, which can be interpreted as new situations, and can thus gradually enhance these experiences, generalizing beyond specific contexts;
- e) students need to learn from the interpreted experiences and explanations of others, including colleagues and specialists. Social interactions, discussions and tips are important; talking about why things happen in such a way is very important. Mentoring is best done with dialogue, with examples, and in most cases right at the time the tip can be used, or at the time the learner is prepared for the hint.

When experiences have the conditions listed above, they are organized in memory in a way that to perform mental simulations that prepare for decision making. Apprentices can then test the events in their mind before acting, they can act in different ways and imagine how goals could be achieved, just as a player tests a game.

Gee (2003) further emphasizes that assertive learning must have three aspects. First, the learner needs to be tempted to experiment, which can be done by creating an identification with the game, by reducing risks and offering rewards. In addition, it must expend great effort on its task, which again can be triggered by the creation of identification with the game, so that the student is focused and immersed in the context of the game. Finally, the effort needs to take place at a level appropriate to the learner's developmental stage, which needs to see that different levels of effort come with different levels of rewards and learning, and for the deepest level of success it is necessary that the game be elaborated in a way that will uncover new knowledge and new identities and values to develop. For this to occur, input amplification is used, which can be somewhat simple, for example, when accelerating a car, the view of the player becomes expanded. That is, the player must feel that his actions have effect in the world.

2.3 Zone of Proximal Development

The zone of proximal development is a theory by Vygotsky (1978) based on the fact that the learning of children begins well before attending school. For every learning situation that the child faces in school, there is a previous history. When beginning to study mathematics, for example, the child already had experiences with quantities and had to deal with operations of addition, subtraction, division and determination of size. Similar learning occurs with any questions, with the assimilation of the names of objects in the environment, the imitation of adults, and so on.

Development is separated into two levels. The first is real development, that is, the development of the mental functions of the child that have established themselves as a result of certain cycles already completed. The second level is the zone of proximal development, where the tasks for which the child has the means to solve but not the necessary experience are located. In this area is all the knowledge that has not yet matured, but is in the process of maturation. That is, it is not at the moment when you can do something for the first time that the learning is complete; at that moment, it's beginning, and from there the possibilities for learning and its improvement are opened.

Thus, development and learning do not go together. The development process progresses more slowly and behind the learning process. It can then be assumed that learning, with its various experiences, is being converted into development: this is the idea of the zone of proximal development.

Thus, Vygotsky's theory might help to evaluate the effectiveness of educational methods, such as games as a teaching tool. In this sense, Vygotsky claims that play creates a zone of proximal development for the child. In play the child always behaves beyond the usual behavior of his age, in addition to his daily behavior. Therefore, it is possible to create situations that maximize the potential of games as educatoinal tools, contributing for students learning.

2.4 Tangential learning

Portnow (2008) defines tangential learning as autonomous learning that occurs when a game, film, or story captivates the learner enough to leave him intrigued by more data, leading himself to seek information about what he desires. A game that uses this strategy is *Assassins Creed*, which has a separate section with lots of information about historical moments presented, places, etc.

One can think of some strategies to teach the player, how to put some facts or small bits of information in moments when the player is not doing anything, as while loading game' screens. You can also draw the attention of the players using references of the most diverse types. *Age of Mythology* is one of the games that, because of the stories based on mythology (Greek, Egyptian, and Roman), ends up captivating their players, sometimes motivating them to seek other information about their favorite Gods, empires or heroes, thus favoring autonomous learning and intrinsic motivation.

For Brown, Li, Nguyen, Rivera, & Wu (10), the secret of tangential learning is the search performed by the learner. As the student looks for a subject on his own, he is focused and interested in learning about it, unlike a classroom where he is "forced to learn" about a subject that sometimes does not interest him.

2.5 Monitor and input hypotheses

Krashen (2009) claims that knowledge relevant to languages is created from two systems: acquisition and learning. On the one hand, the acquisition is explained as a form of internalization of the second language in a process that compares to the learning of the first language by the native speakers, requiring a great interaction with the target language. On the other hand, learning would be a conscious process that would function as a monitor that helps to correct the errors of the formation of sentences before speaking or writing.

Krashen's theory of second language acquisition in the late 1970s, referred by several authors such as Ellis (1997) and Larsen-Freeman and Long (1994), is divided into five hypotheses:

- a) hypothesis of the distinctions between acquisition and learning, cited above, which considers both different;
- b) hypothesis of the natural order in the acquisition of morphemes, which affirms that the rules are learned in a certain order, determined by the complexity and the necessary knowledge;
- c) hypothesis of the monitor: it reinforces that the ability to create sentences in another language comes from an unconscious knowledge, and that conscious knowledge works monitoring. This conscious knowledge serves to edit, that is, to make corrections in the output before creating a text or a speech, being that the focus of this monitoring aims at the grammatical precision;
- d) input or comprehension hypothesis: tries to explain how a leaner acquires the second language. The central premise is that the second language can only be acquired by the learner through understandable input that is provided to him, and that competence in the language will be developed if that input is provided in sufficient quantity. Krashen himself states that a necessary (but not sufficient) condition to evolve from stage i to stage i + 1 is for the learner to understand the input that contains i + 1, that is, that it is focused on meaning and not in the form of the message. In terms of the hypothesis of understanding, acquisition takes place through understanding;
- e) affective filter hypothesis: it deals with affective variables that can condition the acquisition of second language of oral and written texts. It is related to three factors: self-confidence, anxiety, and motivation. Krashen (2009) summarizes his acquisition theory as follows: for acquisition, two conditions are mandatory: the first is an understandable (or better understood) input containing i + 1, structures slightly beyond the current learner level; the second is a low or weak affective filter for the input to be learned.

2.6 Acculturation

Acculturation, in Schumann's view (1986), is the social and psychological integration of the learner with the target language group. The acculturation model has as main idea the acquisition of the language in a natural way through the contact with speakers of the target language. The acculturation hypothesis was proposed after a study of several months observing an immigrant, his successes and his limitations in the acquisition of the language.

Schumann separates acculturation into two types: one in which the leaner is integrated into a second language-speaking group, providing psychological contact and openness to learn it in contact with the input

in social interactions; and another in which, in addition to the characteristics of the first type, social and cultural values are also adopted for speakers of the target language, although such adoption is not a conditioning factor for acquisition, only social and psychological contact with the second language. In the model, there are two types of variables considered very important in acculturation conditioning and, consequently, in the second language acquisition: social and affective.

Larsen-Freeman and Long (1994, pp. 252–253) expose social and affective factors. Among the social ones, can be highlighted:

- a) social dominance: related to the resistance (or lack thereof) that learners of a second language have in relation to dominant culture or politics;
- b) integration patterns: the strategies of approximation and openness with the second language group, involving preservation, assimilation, and adaptation;
- c) closure: it is the factor that involves the distancing of the culture of the speakers of the second language in relation to the learner, making him to maintain contact only with elements related to his own culture and his social groups of origin, thus reducing the acquisition opportunities;
- d) cohesion: the cohesion between the learner and the social groups of the same origin limits the contact with the groups of speakers of the second language, reducing the acquisition opportunities;
- e) size: a social group of the same origin tends to reduce opportunities with groups of second language speakers in proportion to their own size;
- f) cultural congruence: the alignment and similarity between the culture of origin and the culture of the speakers of the second language;
- g) attitude: the attitude that the student's social group of origin and the speakers of the second language have with each other can increase or decrease the acquisition opportunities, depending on numerous factors;
- h) desired residence time: related to the learner's intentions to remain (or not) in touch with the culture of the second language speakers, which could promote greater acquisition opportunities in a longer residence time.

The affective variables would include:

- a) language shock: the fear of making mistakes, more common in adults, reduces acquisition opportunities;
- b) cultural shock: anxiety, fear, or disorientation caused by a new culture can negatively affect acquisition;
- c) motivation: related to the desire to become a member of a group, or have social and (or) economic recognition through the knowledge of the second language;
- d) ego's permeability: the perception of the limits of language, less rigid in childhood.

Schumann's acculturation model has as main hypothesis the relation between the acquisition of second language and the leaner acculturation degree in a group of speakers of the second language, the first being controlled by the degree of the second language. Each degree of acculturation equals a degree of acquisition of second language. However, the social and psychological variables proposed by him, even interfering with acquisition, can not be understood as direct causal relations, since they include several

factors that affect it: social, affective, personality, cognitive, biological, aptitude, personal, instructional, and input (Larsen-Freeman & Long, 1994; Santos, 2011).

2.7 Interaction hypothesis

The interaction hypothesis, proposed by several authors (Larsen-Freeman & Long, 1994; Gass, 2003), emphasizes the negotiated interaction between native and non-native speakers of a language. That is, conversational interaction is the foundation of linguistic development, and not only the exposure to linguistic input, although this is not completely discarded in the hypothesis.

One of the proposals of the hypothesis, therefore, is the negotiation of meaning, especially involving adjustments by the most competent interlocutor to make himself understood by the least competent. Negative feedback during negotiation of meaning is important for there to be a development of vocabulary, morphology and syntax specific to the second language (Gass, 2003). The acquisition takes place through meaningful interaction, and the linguistic production in an interaction with the second language speakers by the learner is a crucial event in its acquisition, which discards the exposure to the input alone.

Table 1 outlines the relationships between the theories presented in this section and the universe of games. The letters in the first column will be used in the analysis of the literature review, in the following section.

	Authors	Links to games	
Α	Gardner,	Game generates students' engagement supported by the goals and rewards of the	
	Brown, and	game. Intrinsic motivation can be achieved if the player feels challenged and	
	Ryan e Deci	identifies with the game.	
В	Gee	The theory can be observed if the game has goals that attract the leaner and	
		feedbacks that encourages him to continue. The space provided by the game	
		should allow the learner to make whatever experiences he deems necessary, but	
		with diminished risks, as opposed to the great rewards that will be given in the	
		case of success (varying according to the level of effort made by the learner). A	
		game that lets the leaner immersed is necessary, so that he realizes that his	
		actions have an effect in the game world, generating thus effort and focus on his	
		part. If there is a teacher, he should be attentive to help the student by giving	
		feedback to contribute to his instruction.	
С	Vygotsky	With the large amount of information passed through the game and the presence	
		of a teacher or partner, if the learner needs help, the possibility of new content	
		being learned is high because of the various interactions that occur in the game.	
D	Portnow and	The game may generate a willingness to research language related topics such as	
	Brown	songs, movies or game items as mythological, historical, or cultural references. It	
		can also involve other aspects of the game itself, such as ways to evolve faster or	
		codes and tips, leading the learner to get in touch with other knowledge and the	
		language he wants to learn.	
Е	Krashen,	There may be interactions with other players, creating a sense of group / culture	
	Schumann,	that generates the motivation to become part of the community, facilitating the	
	Gass, and	learner's input, thus facilitating the acquisition of the second language.	

Larsen-		
Freeman and		
Long		

Relationships between theories and games

3. Literature review

In this section, the concepts and theories presented in the previous section will be used to perform a preliminary analysis of the results of the literature review, ascertaining if the characteristics of digital games focused on entertainment considered relevant to English learning generated positive results. This analysis tries to find out what are the characteristics of the digital entertainment games that motivate and contribute to English learning and what characteristics should be sought in these games so that their use in English learning yields good results.

The article by Sardone and Devlin-Scherer (2010), based on 10 students from 20 to 22 years of age, presents 11 textual and / or puzzle games found on the Internet. The relevant teaching characteristics found in the games were: plenty of written content, repetitive written content (phrases / words), and the need for text interpretation. The theories of learning and motivation that can be found in the games used in the study are: A, B, C, and D. The results of the article indicate that the students showed much more interest in the subjects (increased motivation), identified more with the characters of the stories they read, and paid more attention in class. Even in the case of games that teachers thought would be uninteresting, the attention of the students was greater than in a class without the use of games.

Antonopoulos' course completion work (2014) involved 25 Greek students aged 18 to over 24 who had already played MMORPGs. All participated in a qualitative study with 19 questions (4 personal). In this study instead of a game, a game genre (MMORPG) was used. The relevant teaching characteristics found in this game genre were: social interaction, repetitive phrases, plenty of written content, need for text interpretation, audio, audio text, and complex history. The theories of learning and motivation found in the case of the MMORPG genre are: A, B, C, D, and E. The study concludes that MMORPGs can bring improvements to students' informal learning in the area of grammar and vocabulary. In their research it is evident that the participants believe that they have benefited from the use of games. The study points out that the texts seen in games, both in missions and dialogues and in the chat with other players, lead to an informal learning, given that students have, in addition to texts, a context within the game that helps them understand unknown words. Another point noticed is that games motivate their players, helping in informal learning.

Soares' Master's Dissertation (2012) presents a research carried out with 17 students in a study group and 16 students in a control group, all aged around 20 years. The game used was *Allods Online*, an MMORPG. The relevant characteristics for the teaching of the game in question are: great social interaction, much written content, repetitive written content (phrases / words), need for text interpretation, spoken dialogues, and a complex story. The learning and motivation theories that can be observed in the game in question are: A, B, C, D, and E. Theory E is often found in MMORPGs, one of the most immersive types of games, also because they have tutorials presented by the game, leveling the challenges and rewards for

the player. The results of the dissertation confirm that there is greater engagement in tangential learning activities (playing digital games, listening to music in English, communicating with foreigners, and reading in English). The use of the game may have been one of the causes for increasing the grades of the tests performed. The improvements observed were: (a) spelling development, reading, and interpretation, (b) writing focused on content, and (c) spelling improvement. It was also noticed during the data collection process that there was an increase in the motivation of the players. Learners engaged in active learning of the English language, interacted with other players in English, and learned linguistic aspects through experience with MMORPG Allods Online.

In Santos' dissertation (2011) a hybrid (quantitative and qualitative questionnaire) survey was carried out with 1,171 players between 11 and 38 years old, who spent an average of 5.22 years playing the MMORPG *Tibia*. The relevant teaching characteristics found in the game were: very written content, repetitive written content (sentences / words), need for text interpretation, and great social interaction. The theories of learning and motivation that can be found in the case of the Tibia game were: A, B, C, D, and E. The conclusions drawn by this dissertation show that MMORPGs can be facilitators and motivators for the acquisition of second language of their players, mainly due to the predominantly sociocultural characteristics that stimulate the integration through this second language.

The article by Reinders and Wattana (2011) studies 16 students between 21 and 26 years old who played up to 27 hours a week the MMORPG *Ragnarok Online*. The relevant educational features found in the game are: intense social interaction, repetitive written content (sentences / words), plenty of written content, and need for text interpretation. The learning and motivation theories found in the game were: A, B, C, D, and E. The results of the study show that digital games for entertainment can bring benefits to learners, but pedagogical planning is needed for their use.

Shahriarpour and Kafi's article (2014) is a study of 25 students between 14 and 16 years who had an hour and a half of class per week for three weeks plus two to three hours of play four times a week. The game used was *L.A. Noire*, an action / adventure crime drama. The relevant learning characteristics observed in the game are: plenty of written content, repetitive written content (phrases / words), spoken dialogues, complex history, and the need for text interpretation. The learning and motivation theories that can be observed in the L. A. Noire game are: A, B, C, and D. The conclusions drawn by the article are that games caused increased motivation in learners, helping to improve learning, as well as improved vocabulary acquisition and increased student interactions.

In Noroozloo, Ahmadi, and Mehrdad's article (2015) two English classes were analyzed, each with 30 students (one of the rooms was a control group). The 60 students were women aged 14 to 17 and had classes three times a week for three months. The game used was *The Sims*, a life simulator. The relevant teaching characteristics found in the game are: repetitive written content (sentences / words) and need for text interpretation. The theories of learning and motivation found in the case of game are: A, B, C, and D. The conclusion of the article is that the classroom that used the game as a teaching tool obtained better results in tests, showing that the game was effective for the learning of vocabulary and use of words, as well as for the increase of motivation and interaction in class.

Miller and Hegelheimer's article (2006) is a study of 18 students, separated into three groups,

performing a weekly exercise for 15 weeks. The exercise consisted of performing certain tasks in *The Sims* with some explanations of vocabulary being given with the exercise (one group should use supplementary content, one could use it or not, and the third group did not receive the material). The relevant features for teaching raised in the game are: repetitive written content (sentences / words) and need for text interpretation. The theories of learning and motivation found in the case of game are the same as those cited in the study by Noroozloo et al. (2015): A, B, C, and D. The conclusions of the study are that the game generates a great motivation to the students, besides offering benefits for the learning of vocabulary. They also show that the use of a game along with a supplementary material to help with the doubts has a better result than just the use of a game.

Ranalli's article (2008) was carried out with nine students, who participated in a test before the classes and a new test after the classes. During the lessons, they performed several exercises and were divided first into English levels, then pairs / trios with different native languages, to force them to communicate in English, as well as to do tests with the game, teaching material and class instructions, game and class instructions, or just the game. The game used by the study was again *The Sims*. The relevant features for teaching raised in the game are: repetitive written content (sentences / words) and need for text interpretation. The theories of learning and motivation observed in the case of The Sims game are: A, B, C, and D. The study concludes that digital entertainment games along with theoretical orientations can be adapted for the use of indirect learning, and that their use with supporting didactic material improves the results. It has also been observed that simulation games (like *The Sims*) are popular with students (even with a great diversity of creation / culture) and that students are very open to classes with the use of games.

Menezes' dissertation (2013) was carried out with 12 students, aged 11 to 13, who were separated into two groups, each playing one of the games. They attended classes that used the games and then answered a questionnaire. The games used in this study were *The Sims Social* and *Wetopia*, both Facebook games. The relevant features for teaching raised in these games are: repetitive phrases, need for interpretation of text, and much written content. The theories of learning and motivation raised in The Sims Social and Wetopia games are: A, B, C, and D. The study concludes that there was a great motivation of the students with the use of games in the classroom, pointing out that part of the motivation comes from the teacher playing together with the students. Informal learning was observed, since the students were able to relate the contents of the classroom with the game, making thus learning more exciting and playful. It is also pointed out that a gaming group was necessary because students helped themselves and were helped, causing them to interact more, collaborating thus in the learning. There was an improvement in the students' vocabulary. Thus, the use of these social games gave the participants opportunities to learn in a playful and fun way; all described the opportunity as positive and realized that they had learned.

In the Oktafiya course completion work (2014), a case study with 22 students between five and eight years of age was conducted with guess-style games (image and action / gartic). In this study, the resource used was a blackboard, but it is also possible to use a digital game or a digital slate. The relevant teaching characteristics found in the game are: great social interaction and few words (linked to objects / actions / people). The theories of learning and motivation that can be seen in the case of "image and action / gartic" games are: A, C, and D. The conclusion of the study points out that guessing games with drawings

are beneficial for teaching vocabulary, showing results that indicate high student motivation and increase in vocabulary-related grades.

Luiz's dissertation (2011) was carried out with six students aging from 18 to 30, with two and a half hours duration. The study used the game *Dungeons and Dragons*, an RPG. The relevant features for teaching raised in the game are: plenty of social interaction, repetitive phrases and words, and complex history. The theories of learning and motivation that can be found in the game are: A, B, C, and D. The dissertation concluded that there was an increase in the motivation of students with the use of the game in class.

Smolinski's article (2013) was carried out with two seven-year-old students and analyzed 37 onehour private lessons. The game used was *Club Penguin*. The relevant features for teaching raised in the game are: large social interaction, repetitive written content (sentences / words), and need for text interpretation. The theories of learning and motivation observed in the case of the Club Penguin game are: A, B, C, D, and E. The study concludes by agreeing with the existence of informal learning in the case of game use. Social interaction is high by the union of people through the game, but there is no information about the difference between the physical and virtual presence of the partners. Another important element observed in the study is that outside of class students continued to play, having thus a more intense contact with the second language (at least five hours a week) and voluntarily, forming thus a productive and authentic activity, generating motivation and the continued practice of the second language.

The article by Anderson, Reynolds, Yeh, and Huang (2008) accompanied eight students, all of whom had studied more than six years of English. The study consisted of five sessions with one to three students, who were led by a teacher through the game's training areas. No direct instructions were given, but the student could be in any doubt at any time. The game used by the study was *America's Army*. The relevant features for teaching raised in the game are: social interaction, repetitive phrases, and audio. The learning and motivation theories raised in the game are: A, B, C, D, and E. The study concludes that the game can and should be used as a way of bringing different materials into the classroom, pointing out that the it works in a way similar to movies. A difference in the behavior of the individual student (asking more questions) is indicated in relation to the paired student (isolates more but asks questions to his pair). It is also pointed out that the students who were part of the experiment would take more advantage of the game with a word sheet of the game, since they had difficulty with the speed of speech of the characters.

4. Discussion

This section seeks to identify categories in the summarized texts in the previous section, using the theoretical framework already presented.

Most of the texts presented in the literature review use interviews, questionnaires, and observations as evaluation methods, but some also include tests or tests applied to measure students' progress in the use of the games. Noroozloo et al. (2015) and Soares (2012) used control and experimental groups, whereas Miller and Hegelheimer (2006) and Anderson et al (2008) used three groups, one with compulsory use material, one with material of non-compulsory use, and one without support material.

Chian-Wen (2014) concluded that games that engage the player over long periods are more effective

in influencing learning. Chiu, Kao, and Reynolds (2012) concluded that engaging games that are important to the player has better learning effects than those who only seek practice and better high scores. And for Sardone and Devlin-Scherer (2010), it is interesting to use games that do not proclaim a winner, besides the use of a game in which, regardless of the response or input, the player continues to advance.

Crossing the data obtained with the theories and concepts presented in the theoretical framework, one can conclude that the platform, the complexity, and the thematic of the game are not factors that influence the results in an strong way. All may be targeted by students, but they do not pose a risk of non-acceptance; even a student who does not know how to use certain equipment (video game control, PC, or cell phone), for example, will not have problems in developing skills, given the motivation generated by the game.

The following topics point out some elements common to the revised texts.

4.1 Motivation

All 14 studies analyzed in the literature review conclude that there was an increase in student motivation, whether due to the novelty in the classroom, the change of a class with digital games, or even the motivation created by the use of the game.

In the case of Sardone and Devlin-Scherer's (2010) article, the learners identified more with the characters of the stories they read in the classroom after playing the games; in this specific case, the motivation generated provokes tangential learning, since the student, on his own, begins to look for more stories of his favorite characters.

Soares (2012) study found that the increase in motivation did not influence only engagement: student-players arrived before the scheduled time and asked to stay longer at the end of the scheduled time.

For Antoponoulos (2014), one of the reasons why students feel motivated is because of the different kind of class, which brings games closer to movies.

4.2 Classroom interaction

In Shahriarpour and Kafi's (2014) study as well as those of Noroozloo et al. (2015) and Oktafiya (2014), the motivation caused by the games also brings another benefit to the classroom: increased interaction among students, focused on the subject.

Menezes's (2013) study, in turn, reveals that the motivation caused by the class using games is enhanced by the participation of the teacher as a player, demonstrating the potential that games have to increase the social interaction with people in the same physical space.

Anderson et al (2008) point out as a result of their research a relevant fact: students who play alone or with a tutor will ask more questions; students who play in pairs or more people, interact more with each other, debating and taking their own doubts instead of asking the tutor several questions. Menezes (2013) also encounters the situation of students' grouping in his research, showing that the union of students to answer questions is beneficial, helping both individual and group learning.

4.3 Social interaction in the game

Not only the existence of avatars are considered here: means of communication between players is necessary. The reasons why this is a relevant feature for teaching can be identified in theories such as:

- a) games and the active learner of Gee (2003, 2008), since the leaner in this case will try to communicate with other players using the second language. In this environment, "risks" are lower than those of real life, since there will not be as much shame inside the game, for example. There are two additional points to note: the need for a great effort on the part of the learner and the need for an appropriate level for their development, which, in this case, depends a little more on the stage of the language learning in which the game is used;
- b) tangential learning theory of Portnow (2008) and Brown et al. (2014). From these theories, one can see that when a leaner is interested in the subject that is approached in a game, this may lead him to seek knowledge independently, which can be done by researching on the theme of the game, or, in the case that interests this research, trying to learn more English so that you can communicate better in the game and overcome certain challenges, or even the search for a word or certain words, an internet guide, or game tips, thus leading the student to learn content related to teaching of the second language in an autonomous way;
- c) the input or understanding hypothesis of Krashen (2009) can be observed in social interaction at times when the learner tries to communicate, so that the input the learner receives would help in the development of language competence. In this hypothesis, the focus is the understanding of the messages received, which will bring the acquisition of knowledge;
- d) Schumann's acculturation model (1986) can be observed in social interaction at the moment the player immerses in the game and begins to participate in his community, functioning as a moment of acculturation of the player. The interaction hypothesis proposed by authors such as Gass (2003) and Larsen-Freeman and Long (1994) is observed in the social interaction between the learner and the other players (native speakers or not). In this hypothesis, conversational interaction is the foundation of linguistic development. One of the points of the proposal, however, is that the most competent interlocutor helps the less competent in understanding, which can occur through feedbacks (which may or may not happen in the game).

The genres of game that usually present this characteristics are MMOs in general, of all the types, but any game that presents some form of contact between players might have this characteristic.

The studies analyzed in this article that present this characteristic are those of: Santos (2011), Reinders and Wattana (2011), Anderson et al (2008), Antonopoulos (2014) and Smolinski (2013).

4.4 Tangential / social learning (non-local)

The study by Soares (2012) points to a very common tangential learning case: leaners were often curious about words or phrases seen in game contexts or being spoken by other players, and searched the meanings on their own to better interact with the game and its community. In this way, the student may end up engaging in various forms of tangential learning activities, such as listening to music and reading texts in English.

The same was observed in Santos's (2011) study, which demonstrates how MMORPGs can be facilitators and motivators for the acquisition of second language by the players, mainly due to their predominantly sociocultural characteristics that stimulate the interaction and integration through this second language. Thus, a second language teacher can use an MMO to put the student close to people who speak that language to instruct him in the reading of conversations. And because there are communities in games, a community that speaks a language other than the language of the player leads him to want to learn the new language so that he can be part of that community. In addition, you can even train reading and listening with characters controlled by the game.

Antonopoulos (2014) and Smolinski (2013) confirm the findings of Santos (2011), presenting cases in which the players themselves perceive that they evolve greatly due to social contact within the MMOs, whether talking to other players or just reading their conversation. Both point to the benefits of in-game entertainment, which is why players spend so much time in these games, keeping in touch with the English language.

Thus, it can be observed that practically all the games analyzed in this research that enabled a chat contact bring the benefit of social interaction in the second language. The research by Reinders and Wattana (2011), however, does not show similar results, since a modification was made in MMORPG *Ragnarok Online*, greatly limiting the chances of this contact. The study by Anderson et al (2008) also does not present results of this type, but the game community is active and present and helps the players evolve, pointing again to the positive results observed previously. However, the study of Menezes (2013) does not present the indicated benefits because the social games used in the research do not offer tools for direct social interaction, that is, there is no means of communicating in these games.

It can be noticed that MMOs are the most suitable gender for benefits related to tangential learning and social interaction in English for the classroom, since they bring the possibility of direct interaction among the players.

4.5 Grades

Authors such as Soares (2012), Oktafiya (2014) and Noroozloon et al. (2015) show that games associated to lectures guided by teachers have a beneficial effect on students' grades compared to students of the same levels who have not used games in their classrooms.

All the texts analyzed also show that there is an improvement in one of these points in some way: learning words, better understanding of English pronunciation, or even evolution in reading.

In Oktafiya's (2014) study, there is an improvement in students' grades. Soares' (2012) conclusion indicate that positive results were generated on the player's test grades. In Noroozlo et al's (2015) study, a test was proposed after 20 classes, in which the students taught with games had better grades than the standard room.

Chian-Wen (2014) performed a meta-analysis of 25 studies, noting that all show an improvement in student performance ($0.6 \sim 0.7$). In another meta-analysis, that of Chiu et al. (2012), involving 1,116 students, beneficial effects of games in learning were also detected.

4.6 Complementary material

The analyzes of Ranalli (2008), Anderson et al (2008) and Miller and Hegelheimer's (22) studies conclude that the use of the digital entertainment games together with complementary materials (translations of expressions, words, or a targeting of the tasks of the game) is more positive than the use of an isolated game, presenting better results in qualitative and quantitative researches. Students who used the extra material reported having greater ease on their own, and in surveys where tests were performed, students using the extra material scored the highest.

4.7 Vocabulary

Shahriarpour and Kafi (2014) identify an improvement in students' vocabulary acquisition. Oktafiya (2014), in turn, concludes by saying that drawing guessing games are beneficial for vocabulary teaching. Miller and Hegelheimer (2006), Noroozloo et al (2015) and Ranalli (2008), whose studies are carried out with the same game (*The Sims*), show that students had a significant improvement of vocabulary, linking this result to repetitions in conjunction with the animations of the actions performed by the students' commands, thus facilitating their understanding and learning. A similar result can be found in the Menezes (2013) investigation using two games, *Wetopia* and *The Social Sims*; the first involved several repetitions of words and tips, while the second has the same characteristics of the game *The Sims*, with some changes that make it possible to visit other players, but limiting social interaction to the avatars. The students of Menezes' research (2013) believe that the learning was facilitated by being able to relate the contents seen in the classroom with the actions taken in the game. The students analyzed by Antonopoulos (2014) follow the same line of reasoning, believing that the repetition of words, together with the content seen in the classroom and all the different contexts where the game presents the words, facilitates their understanding and learning; in this study, social (non-local / physical) interaction is also pointed out as a facilitator.

Santos (2011) believes that because of the social interaction and repetition of words within the game, even forcing the player to write in order to speak with the NPCs, a perfect learning environment is created for learning, from the actions of the player or by his observation (reading conversations of the players or of the players with the NPCs); this environment ends up being a facilitator for the acquisition of the second language.

Soares (2012) concludes that the experiment period may have generated positive results in the test scores of the gamers, in relation to the control group, mainly in: spelling development, reading, and interpretation; writing with focus on content; and spelling accuracy.

Combining these information with the theories and concepts presented in the theoretical framework, it can be observed that all analyzed games that bring benefit to the vocabulary of the players involve some kind of repetition. It can also be observed that, for the most part, these repetitions need to be interpreted, and this interpretation is aided by the game, by placing the players in different situations, facilitating thus their understanding and learning.

4.8 Repetitive writing content

The games that contain this feature are those that have somehow some written content that is

repeated; in this specific feature, other forms of content (audio) are not considered. The reasons why this is a relevant feature for teaching can be identified in the following theories:

- a) games and the active learner of Gee (2003, 2008), since the leaner will be immersed in an environment, realizing his experiences to acquire new knowledge about the world of the game. In the case of repeated words seen through the new experiences, it is possible to acquire not only knowledge about the game but also about the language, since in the student's experience the language barrier itself be an obstacle to be overcome. This overcoming can be aided if the leaner has a tutor who helps him with the meanings, because repetition (of words and experiences) could be acquired more quickly;
- b) Vygotsky's (1978) zone of proximal development. Since the leaner will be experimenting in the game, the repeated words that are in the zone of proximal development can be understood by him. According to this theory, not only will new words be acquired: expressions, the semantics of language and the formation of sentences, all the work of reading, understanding and writing are being worked on;
- c) Portnow (2008) and Brown et al's (2014) tangential learning theory. The words you see in the game may pull some memory or make the player interested in something that is not told on the game. As an example, one can think of mythology's stories not told, or barely seen in the game, old legends, or even food recipes. This information that a game brings can awaken a curiosity in the leaner that makes him study on his own some subject of his interest, contributing thus to the learning of the language. And it's not just about issues out of the game; for example, in an MMORPG, the learner may want to learn how to make a character with different abilities, and so enter sites in English to find the information;
- all the content seen in "social interaction", since some parts of social interaction are always repetitive, such as presentations, interaction beginnings, and farewells (here only the interactions via text are being analyzed).

It was not possible to identify a specific genre that usually presents this characteristic more intesively, but any game that includes some form of repetition has this characteristic, such as a mechanics of choices that is repeated many times during the game (games that have stores, levels battles, and / or dialogue / action choices); so games that have plenty of written content are presented here as those that bring this feature.

The researches studies in this article that present this characteristic are: Soares (2012), Santos (2011), Reinders and Wattana (2011), Shahriarpour and Kafi (2014), Noroozloo et al. (2015) Miller and Hegelheimer (2006), Luiz (2011), Ranalli (2008), Anderson et al (2008), Antonopoulos (2014), Smolinski (2013), and Menezes (2013).

4.9 Plenty of written content

Games that have this characteristic can be worked with the same theories seen in repetitive written content, since they have the same textual basis, working here reading, understanding and, in some cases, writing.

Again, MMOs appear as the genre where this characteristic is more intense.

The studies analyzed in this article that present this characteristic are: Soares (2012), Sardone and Devlin-Scherer (2010), Santos (2011), Reinders and Wattana (2011), Shahriarpour and Kafi (2014), Luiz (2011), Antonopoulos (2014), Smolinski (2013), and Menezes (2013).

4.10 Need for text interpretation

Games that have this characteristic can be worked with the same theories seen in "repetitive written content", since they have the same textual base, working here reading, understanding and, in some cases, writing.

It was not possible to identify a specific genre that usually presents this feature more intesively, but games that have a lot of written content are presented here as those that bring this feature.

The studies analyzed in this article that present this characteristic are: Soares (2012), Sardone and Devlin-Scherer (2010), Santos (2011), Reinders and Wattana (2011), Shahriarpour and Kafi (2014), Noroozloo et al. (2015), Miller and Hegelheimer (2006), Luiz (2001), Ranalli (2008), Anderson et al. (2008), Antonopoulos (2014), Smolinski (2013), and Menezes (2013).

4.11 Audio

Games with this feature are those in which the characters (of the player or NPCs) have speech (accompanied or not of text) or have an audio chat for communication between players. This includes games that have songs sung (with lyrics).

The reasons why this is a relevant feature of teaching can be identified in theories such as:

- a) games and the active learner of Gee (2003, 2008), because the audio of the game generates new experiences to the learner (who already has some bases of English), which together with the immersive environment will bring new knowledge to the student. This experience will be amplified if the leaner is with his tutor;
- b) Vygotsky's (1978) zone of proximal development, since when the learner listens to sentences in English, in addition to training his hearing to what he already knows, words or expressions that contain some new words can be understood, being seen at different moments or contexts, which happens many times in the case of games;
- c) Portnow (2008) and Brown et al's (2014) tangential learning theory. With the audio of the games, the learner can discover something that holds his attention, which can be a song, story, or a place in the real world that makes him search the game or out of it on his own. This contact with the language is beneficial to your training and learning;
- all the content seen in "social interaction", since some parts of the social interaction are always repetitive, such as presentations, interaction starts, and farewells (here only the interactions via audio are being analyzed).

It was not possible to identify a specific genre that usually presents this characteristic more intensively, but games produced by big companies, better known as "AAA", have for the most part this characteristic, regardless of their gender.

The stude s analyzed in this article that present this characteristic are those of: Shahriarpour and

Kafi (2014) and Anderson et al. (2008).

4.12 Audio text

Games that contain this characteristic can be worked with the same theories identified in "audio" and "repetitive written content", since in this case both types of inputs will be used simultaneously.

It was not possible to identify a specific genre that usually presents this characteristic more intensively, but again games produced by big companies, "AAA", have for the most part this characteristic, regardless of their gender.

The studies analyzed in this article that present this characteristic are those of Shahriarpour and Kafi (2014) and Anderson et al. (2008).

5. Conclusion

This article has conducted a literature review to identify characteristics of entertainment games that may be useful for teaching English as a second language, trying to associate these characteristics with games genres.

The characteristics identified in the studies and games analyzed were: motivation, classroom interaction, social interaction in the game, tangential learning, grades, complementary material, vocabulary, repetitive written content, plenty of written content, need for text interpretation, audio, and text in audio. One of the possibilities to test and validate these characteristics is to create control groups to study if the manipulation of each one of them generates the results pointed out in this article.

Despite the focus on the English language, several of the results of the review serve to teach other languages. The study, therefore, works as reference to guide the choices of games by language teachers.

The fact that there was no delimitation in the age of the students that were part of the several studies analyzed can be considered a limitation of this research. In this sense, future studies can replicate this research seeking to delimit the age range, for example by preschool, elementary education, middle education, higher education, and college/university, seeking to identify specific characteristics for each age group.

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Cyanobacteria Occurrence in Photosynthetic Stabilization Ponds

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Abstract

Photoautotrophic organisms, particularly cyanobacteria, have great ecological importance due to their photosynthetic capacity, and biosynthetic versatility in diverse and extreme environments. However, photosynthetic ponds, they may be serious and dangerous producers of potentially toxic toxins. Their release and bloom in treated effluent receiving bodies are a major concern because of the negative consequences on aquatic biota and the risks to public health. The aim of this study is to analyze the occurrence, composition, density and spatio-temporal distribution of cyanobacteria in sewage treatment plants by photosynthetic ponds in ten cities located in the central region of the São Paulo State, Brazil. The results recorded high densities of Microcystis sp. with a maximum average of 9.4x105 cells per millilitre (cells/mL); Synechococcus sp., with an average of 7.8x105; Synechocystis aquatilis with 7.2x105; Merismopedia tenuissima with 4.8x105; and Phormidium sp. with 1.9x105. Among these species found, the highest occurrence was M. tenuissima. The high densities show that these ponds are an aquatic environment conducive to the development of cyanobacteria and, potentially, an important source of cyanotoxin production. Therefore, studies and monitoring of the effects on the receiving water bodies are recommended by determining their cyanobacteria densities and investigating the possible presence of cyanotoxins.

Keywords: Cyanobacteria; sewage treatment plants; photosynthetic stabilization ponds.

1. Introduction

Planktonic cyanobacterial flora communities are distributed in a range of ecologically diverse habitats of estuarine and marine water, soil, as well as extreme habitats such as hot springs and Antarctic and Arctic environments (Sompong et al., 2005; Taton et al., 2006).

They are primarily distributed in freshwater aquatic ecosystems in almost all tropical, subtropical, temperate, polar and sub-polar latitudes around the world (Kosten et al., 2012; Vincent & Quesada, 2012;

Paerl & Otten, 2013).

Some genera of cyanobacteria, such as Dolichospermum and Aphanizomenon have a cosmopolitan distribution (Sheath et al., 1996; Sheath Muller, 1997; Tang et al., 1997); others are apparently more restricted to cold waters in temperate regions, such as most Oscillatoria sp., or to tropical and subtropical waters, such as Cylindrospermopsis and Spirulina (Padisak, 1997; Whitton & Potts, 2000; Karadžić et al., 2013).

Cyanobacteria are collectively referred to as those that constitute an old group of photosynthetic, highly adaptable and abundant prokaryotic phytoplankton organisms, which are recognized as important causes of environmental issues, having serious implications for human health and water-related economic activities (Azevedo & Vasconcelos., 2006; Tsukamto & Takahashi, 2007; Santos & Bracarense, 2008). In surface fresh waters, their abundance, biomass, and species composition are widely known for varying greatly in time and space (Knoppers et al., 1984; Graham et al., 2006; Prentice, 2008; Sarika et al., 2010). Excessive proliferation of cyanobacteria in the form of intense blooms is generally correlated with various combined environmental factors, such as nutrient availability, especially nitrogen and phosphorus compounds (Chorus & Bartram, 1999; Whitton & Potts, 2000), a wide range of seasonal variations of light intensity, temperature, hydrographic and hydrological conditions (Sangita Ganesh et al., 2014; Lorena et al., 2015). Many of these factors are the result of anthropogenic activities, which are much more important than the natural causes of cyanobacteria proliferation.

It is known that the increased accumulation or availability of phosphatic and nitrogenous compounds in temperate, mainly tropical continental environments, provide an increase in the primary productivity (Smith, 1983) and play a key role in regulating the composition of the cyanobacteria community (Andersson et al., 2015). Consequently, the environmental factors may benefit species selection through competitive mechanisms (Calijuri et al., 2006).

The main concern with the occurrence of high densities of cyanobacteria in water bodies, especially in water sources, is the fact that some of these organisms are known to produce and release more than one type of cyanotoxin into the waters. Moreover, there may be several strains producing toxins within the same species (Furey et al., 2005; Soltero-Santos et al., 2005). The Brazilian legislation on surface water quality, CONAMA Resolution No. 357/2005, establishes that the limit for the density of cyanobacteria in Classes 1, 2 and 3 water bodies is 20,000 cells/mL, 50,000 cells/mL and 100,000 cells/mL, respectively (Brasil, 2005). Class 1 and 2 water bodies are not very polluted and are generally used as springs.

In Brazil, facultative photosynthetic stabilization ponds have been widely used to treat sanitary and industrial sewage due to the fact that they are simple to construct, operate and maintain. They are also inexpensive and efficient in removing pollutants. However, these ponds, that have high nutrient contents, constitute a habitat which favours conditions for the intense development of phytoplankton, mostly cyanobacteria, having high concentrations of bacteria, algae and cyanobacteria in the final effluent, which interact mutually (Pearson, 1987; de Oliveira, 1990; Abdel-Raouf et al., 2012).

The high densities of cyanobacteria, although contributing significantly to the aquatic primary production and to the process of removing atmospheric CO2 and its conversion into organic matter and O2, playing a relevant role in the plankton. Together with eukaryotic microalgae, are an inconvenience insofar as they may cause problems concerning toxicity, colour, smell, taste and altered appearance in the supply water, as well as operational problems in the water treatment plants, leading to limitations for drinking water treatment or similar issues (Smith et al., 2008; Rosales et al., 2008, Abdel-Raouf et al., 2012).

2. Methods

2.1 Study Subject

The object of study consisted of ten sanitary sewage treatment plants by facultative photosynthetic stabilization ponds (LF1 to LF10), from cities in the central region of the São Paulo State, southeast Brazil near the city of São Carlos. The criteria for choosing the cities/ ponds were the proximity to São Carlos and easy access to the sampling points. A sampling point was established for each pond at the outlet of its effluent and the ponds were georeferenced.

Table 1 lists the ten cities and their respective ponds, the location of the sampling points considering the geographic coordinates and the respective receiving water bodies of treated sewage and their Class.

City	Pond	Location	Receiving water body
Analândia	LF1	S 22°08'36,9" and W 47°39'81,5"	Corumbataí River, Class 2
Brotas	LF2	S 22°17'28" and W 48°08'72"	Jacaré Pepira River, Class 3
Itirapina	LF3	S 22°24'59,4" and W 47°50'27,5"	Água Branca Brook, Class 2
Charqueada	LF4	S 22°35'24,5" and W 47°42'20,3"	Corumbataí River, Class 2
Ipeúna	LF5	S 22°26'52,6" and W 47°42'46,8"	Lavadeiras Brook, Class 2
Corumbataí	LF6	S 22°14'06" and W 47°36'95,2"	Corumbataí River, Class 2
Guariba	LF7	S 27°21'04,2" and W 48°09'4,85",	Guariba Brook, Class 4
Santa Lúcia	LF8	S 22°40'02,4" and W 48°05'98,5'	Ponte Alta Brook, Class 2
Santa Eudóxia	LF9	S 21°46'60,2" and W 47°47'17"	Quilombo River, Class 2
Ibaté	LF10	S 21°56'70,7" and W 48°01'72,3"	São José das Correntes Brook, Class 2

Table 1. Sampling point coordinates and receiving water bodies.

Figure 1 shows the location of the ten ponds studied and their respective cities in the State of São Paulo and in Brazil.



Figure 1. Location of the ponds studied and their respective cities.

2.2 Field Sampling Procedures

From May, 2012 to April, 2013 monthly samples were taken to identify and characterize the distribution of cyanobacteria qualitatively and quantitatively. For the qualitative analysis, the samples were collected and filtered through a 20 μ m nylon conical plankton net, dragged horizontally at each collection site on the subsurface (approximately 0.5 m deep).

For the quantitative analyses, the samples were collected using a bucket (capacity 5 litres) and a cup (capacity 1 litre) made of stainless steel - AISI316. Immediately after the samples were taken, the seston was packed in 250 ml polyethylene plastic bottles containing 4% formaldehyde solution to fix the samples and preserve them, which were stored in polystyrene boxes with crushed ice and transported to the Sanitation Laboratory of the Civil Engineering Department at the Federal University of São Carlos in order to be analysed.

2.3 Identification and Quantitative Evaluation of Cyanobacteria

For the traditional classical taxonomic identification of the network samples, even at the species level, they were analyzed using a common optical binocular microscope with a magnification of 400 to 1000x, coupled to a clear and ocular camera. The identification was primarily based on the following identification
keys adopted by Desikachary (1959); Anagnostidis & Komárek (1988); Komárek & Anagnostidis (1989); Komárek & Anagnostidis (1999); Komárek & Anagnostidis (2000); Komárek & Anagnostidis (2005); Komárek & Cronberg (2001); and Sant'Anna & Azevedo (2000).

The Utermöhl method was used to estimate the density of the cyanobacteria by numerical counting. The technique using transparent cylindrical acrylic sedimentation chambers of different known volumes was adopted, as described by Utermöhl (Utermöhl, 1958), using a Coleman binocular inverted microscope N/B100, with an ocular micrometer scale coupled to a microscope with a magnification of 400 to 1000x (Anderson & Thröndsen, 2003). The results were recorded in cells/mL.

2.4 Statistical Data Analysis

Due to the possibility of extreme results and the occurrence of a non-normal distribution, the data were statistically analysed using the nonparametric Kruskal-Wallis test (Viali, 2008). In the present study, the significance level of 5% was set for all tests in order to record the similarity or difference between the groups of samples.

3. Results and Discussion

Cyanobacteria were identified in all the stabilization ponds and their cell concentrations were determined for each sample in their spatio-temporal distribution during the twelve-month study period.

Observations concerning the periodicity of cyanobacteria occurrence show that conditions of low annual temperature variations, characteristic of tropical regions and non-thermally stratified waters are optimal conditions for the occurrence and development of the main cyanobacteria genera. (Calijuri et al., 2006; Reynolds, 2006). This was the case of the temperatures observed in the ten ponds, which were generally within the range of 25° to 30° C. However, more detailed studies are needed to verify some temporary stratification.

The genera of cyanobacteria found in the present study differ little from those recorded by Aquino (2010) and Aquino (2011) in photosynthetic stabilization ponds in the Ceará State as well as those observed by Konig et al. (1999) in the Paraíba State, Brazil.

Six species of cyanobacteria were common in the ten studied ponds: M. tenuissima, Aphanocapsa sp, Lyngbya sp, Pseudanabaena sp, Microcystis sp e Spirulina sp. On average, M. tenuissima appeared more, suggesting that this species best adapts to the hypereutrophic environment of the ponds. Lyngbya sp was the second most abundant species. The genus Merismopedia, to which belongs the species M. tenuissima, adapts very well to different environments/habitats (Brettum, 1989, Blomqvist, 2001, Tian et al., 2012). The genera Microcystis and Planktothrix are considered to be toxin producers by Sivonen & Jones (1999). Furtado et al. (2009) report the coexistence and even the alternation between Microcystis sp. and Merismopedia sp. with Planktothrix sp. and Cylindrospermopsis sp. in sewage treatment ponds.

The densities of the cyanobacteria found in the present study are presented in Table 2.

Month	LF1	LF2	LF3	LF4	LF5	LF6	LF7	LF8	LF9	LF10
05/2012	121,139	17,289	3,956	31,875	62,334	3,093	*	<u>949,119</u>	361,300	12,048
06/2012	98,462	10,510	14,510	4,704	77,823	52,925	0	437,034	138,310	75,730
07/2012	442,218	7,745	6,704	8,468	*	12,898	230,322	27,613	451,962	112,867
08/2012	16,038	9,409	0	9,408	130,547	32,930	2,352	11,516	137,605	34,107
09/2012	174	56,667	27,639	36,851	48,220	53,631	2,303	2,205	87,522	29,403
10/2012	28,227	43,516	1,176	11,761	197,586	58,217	106	4,410	109,378	3,528
11/2012	13,819	31,093	4,234	19,942	<u>801,518</u>	18,999	5,881	1,764	48,367	865
12/2012	3,458	28,227	33,208	19,994	186,794	114,082	4,704	17,642	19,759	14,113
01/2013	2,487	152,012	248,747	34,107	*	137,605	10,364	576,293	100,190	20,582
02/2013	2,211	41,458	11,761	52,925	301,084	255,804	37,312	717,426	91,207	100,408
03/2013	6,910	6,910	148,823	108,960	223,234	154,138	113,067	<u>963,030</u>	10,364	134,206
04/2013	6,495	351,068	152,012	107,099	150,542	77,623	171,013	<u>884,433</u>	<u>981,168</u>	18,524
Average	61,803	62,992	54,398	37,175	<u>217,968</u>	80,995	52,493	<u>382,707</u>	<u>211,428</u>	47,365

Table 2. Densities of the cyanobacteria recorded in the facultative ponds studied (cells/mL).

* No sampling.

As can be seen in the previous table, the densities or concentrations and distribution of cyanobacteria were very varied in the ponds and over time, the following ponds stood out: Ipeúna - LF5, Santa Lúcia - LF 8 and Santa Eudóxia - LF 9 for their high values with averages above 200,000 cells/mL and maximum values greater than 800,000 cells/mL (see Table 2).

High densities can be produced by a number of combined biotic and abiotic factors resulting from eutrophication and other processes: low turbulence, low water transparency, low or high pH values, high water temperatures, thermal stratification, high light incidence and availability of nutrients, although many of their species are able to fix atmospheric nitrogen and transform it into assimilable forms (ammonia and nitrate), and are also able to store phosphorus in the form of polyphosphates (Reynolds, 1984; Reynolds, 1987; Reynolds, 1998; Crayton & Sommerfield, 1979; Sant'Anna et al., 2008). Chorus & Bartram (1999) state that as the decomposition of the sewage occurs throughout the stabilization ponds, the number of species in their effluents released into the receiving bodies of water generally decrease.

According to (Harsha & Malammanavar, 2004), the high turbidity and high contents of dissolved solids favour the growth of cyanophytes. The presence of the high density of cyanophytes indicates high pollutant load and a nutrient rich condition (Muhammad et al., 2005; Tas & Gonulol, 2007). According to Chorus & Bartram (1999), flowering densities above 10000 cells/mL of cyanobacteria can be considered.

Figures 2 to 4 show the seasonal distribution of densities in the effluents of the richest cyanobacterial ponds: Ipeúna - LF5, Santa Lúcia - LF8 and Santa Eudoxia - LF9, for the twelve months of sampling. In the Ipeúna pond, there was no sampling from July, 2012 to January, 2013.



Figure 2 - Densities of cyanobacteria in the effluent of the Ipeúna pond.



Figure 3 - Densities of cyanobacteria in the effluent of the Santa Lúcia pond.



Figure 4 - Densities of cyanobacteria in the effluent of the Santa Eudóxia pond.

High densities of more than 20,000 cells/mL in the treated effluents deserve attention and systematic and detailed research. Depending on the flow rate and the dilution and environmental conditions (potential for flowering) of the receiving water bodies, they can result in values above the legal limits set forth in the CONAMA Resolution 357/2005, whose lowest density is 20,000 cells/mL for water bodies belonging to Class 1, with low pollution (Brasil, 2005).

Seasonal variations of cyanobacteria concentrations with maximum values in the sunny months were observed in the studies carried out by Oswald (1988) and Zulkifli (1992). It can be observed that there is currently a large proliferation of cyanobacterial blooms occurring in freshwater ecosystems at all latitudes leading to growing concerns for scientists and water resource managers (Wilhelm et al., 2011). Damas (1964) believes that in the intertropical zone, plankton can appear in any season of the year. According to Paerl & Otten (2013), to explain the true causes of fluctuations in algae and mixoficea populations, appropriate and case-specific studies would be required.

5. Conclusions

The results show the occurrence of various species of cyanobacteria at high concentrations, above 20,000 cell/mL, indicating the risk of contamination of the receiving water bodies beyond the limits of the Brazilian legal standards of water quality for these organisms.

In general, cyanobacteria dominated the growth of the flora in the ten ponds studied, emphasising more the ponds in the cities of Ipeúna, Santa Lucia, and Santa Eudóxia. The three main genera found were Merismopedia, Pseudanabaena and Limnothrix, and the presence of Merismopedia is considered common in photosynthetic ponds around the world.

Among other registered genera, it is worth mentioning Planktothrix and Microcystis as they are related to the production of potentially toxic cyanotoxins, showing evidence of effluents at a greater risk to the receiving bodies and public health. However, in the present study no significant or dangerous concentrations of cyanotoxins were detected.

Thus, detailed studies involving not only the stabilization ponds and their operational conditions, but also their receiving bodies and continuous and systematic monitoring are of the utmost importance concerning the presence of cyanobacteria and, if necessary, cyanotoxins.

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Current Trends in Software as a Service (SaaS)

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Abstract

Software as a service (SaaS) is one type of the cloud computing that has gained more popularity in the world. It is a way of delivering the software through the internet to its end users. Then users can use it through subscriptions from vendors. Users have to pay only for what they use. SaaS architecture is a very high level model which is based on Application Service Provider (ASP) concept and Service Oriented Architecture. Currently many organizations are using SaaS as it is a service centric model and it uses technologies like multi-tenant architecture which in turn provides the users with many desired set of features. SaaS also have some security challenges which can be classified under data, application and deployment of SaaS architecture. Furthermore there are many emerging trends in SaaSwhich are focused on full filling advanced customer demands. This research study is evaluating the current trends, approaches and applications of SAAS.

Keywords – Software as a service (SAAS), SAAS Architecture, Multi-tenancy, Security challenges

Introduction

The world is rapidly changing everyday with the use of internet into many different purposes. Cloud computing is such a trend which entire world has embraced recently. Cloud model consists with three essential components and Software as a Service (SaaS) is one of them. Although SaaS is a newly emerging business model in the software industry its growing speed is very high. This is mainly because it delivers a lot of benefits and facilities to the end user (Levinson, 2007).

SaaS is a software distribution model where applications are hosted by the service provider. It is made available to the end users though the internet (Levinson, 2007). Here the software vendors host and maintain the servers which includes code and database in the application. Customers do not have the ownership of the software but they rent it normally for a monthly feeHence many people embraced SaaS quickly as it promised to give their services to overcome almost all issues related to packaged software. It delivered easier, speedier and cheaper services and therefore customers were attracted to it. If anyone has internet connections they could access data on SaaS application from any device (Hancheng 2009). Unlike

traditional packages, the SaaS vendors own the software and host it. SaaS vendors also take care of upgrading, security, and maintenance of the software. Hence, SaaS is sometimes known as hosted software or "on demand software" (Levinson, 2007). In SaaS the user can run software without expending for investments in database, servers and software licensing. In SaaS all customers use the same software and it cannot be customized. SaaS service providers add features based on different clients feedbacks and reviews. Then those features will be available to all users ultimately which is known as the multitenant architecture (Hancheng 2009).

On the other hand, security is an important thing in SaaS applications. Data can be owned by the users through negotiations with the vendors. So in terms of data ownership in SaaS, users should make sure that they hold the ownership of data. In real world vendors take more measures and invest more in security, privacy, recovery and maintenance than other usual enterprises (Levinson, 2007). Nevertheless SaaS also faces with different security challenges. Those security challenges can be further divided as security of data, security of application and security of deployment. There are also some countermeasures which can be taken to face those security issues and they are discussed further in this article (Yao et al, 2015)

Here, a deep analysis and a review of the SaaS has been done with its evolution and architecture. This article mainly focuses on giving a good understanding on what is happening in SaaS and what are its benefits. So the organization of the article is as follows. First it discusses about the SaaS and its functionality (Yao et al, 2015). Then its evolution has being explained and thereafter the architecture of the SaaS has being discussed with respect to its maturity levels an architectural levels. Next the benefits of SaaS have been analyzed descriptively (Levinson, 2007). The security challenges faced by SaaS users and service providers have been presented in the next section and finally emerging trends of the SaaS have been described.

Why Software as a Service?

Today software is a very common attribute in all business areas such as sales, production, managing inventories, recruiting and training of employees, managing customer relationships, financial and accounting activities and many more. So to handle all these activities people use on premise software which needs to be installed and maintained by themselves. They also have to pay a large cost for the infrastructure needed in order to store data and manage their security. As an alternative for this people have introduced SaaS where software is given as a service over the internet by service providers (Levinson, 2007; Yao et al, 2015).

It is a model where providers give their service so that users can pay as they use it instead of having the entire application with them. They also provide their services at any time of the day. Therefore SaaS has changed the way of building, selling as well as using the software. This was introduced at a time when people were fed up with the traditional software. As they were facing with a lot of difficulties in traditional software like unwanted costs , licenses and many more they were attracted and moved to SaaS without a

pull from the vendors. SaaS has also promised with higher values such as speed, quality, easiness and low cost and it has rapidly become an emerging passion in the business world (Yao et al, 2015)

Currently SaaS is relying on many technologies like web services and Service Oriented Architecture (SOA). In this case every software gets the chance to act as a service provider. A service provider exposes its functionality and operations through a public broker. Also it can act as a service requester. In this case it cooperates data and functionalities from other services (Satyanarayana, 2012). In the multitenant architecture where thousands of users use one instance of the server which is hosted on the server side. This has helped to reduce the cost on resources which in return has given the chance for the users to rent the application as they use it (Yang, 2011).

SaaS is also known as on demand software (Mahesh, 2014). With the development of technologies like Web 2.0 and HTML 5.0, the quality of the graphics and other functionalities has increased and users feel like they are using software which is running on their personal computers. For this simplicity it has been embraced by many people all over the world (Mahesh, 2014). As SaaS providers use the concepts of multi-tenancy and virtualization it has helped to improve efficiency and more successful resource utilization. According to some researches it has been said that SaaS is five times faster than on premises (Mahesh, 2014).

Evolution of the Concept of Software As A Service

Even though the term SaaS has been more popular in these days, the idea has emerged around in 1950s. In those days though they had this idea the needed infrastructural facilities and other technologies were not very much available (Yao et al, 2015; Yang et al, 2011). Concept of SaaS is a bit similar with Application service Providers (ASP) which emerged around 1990 due to the expansion of the internet and centralized computing. Asp tried to give all things to all users and serve unique needs of their customers. So as a result they lost the economies of scale and failed.

The concept of ASP was similar to that of SaaS where ASP also hosted applications and delivered them over the internet (Yang et al, 2011). The concept of cloud computing has helped for the SaaS to a huge extent. Cloud computing is a concept of distributed computing around the internet where users have given the permission to access the data. It is a more dynamic and flexible mechanism where it provides services and data to the users and the providers take care of maintenance, deployment and storage over the network (Yang et al, 2011). Today the cloud has categorized based on the service delivery models or the type of service set they provide. They are described below.Infrastructure as a Service (IAAS) : IAAS is the lowest layer of the network. This basically provides the needed computing power and storage resources. This makes a virtual pool where the users can use the computing power and storing facilities (Yang et al, 2011).

Platform as a Service (PAAS): Then there is the PAAS and it is created upon the infrastructure layer and make a higher level of abstraction. It provides middleware, operating system and many more while the user

only needs to install applications on it. Therefore it gives the facility to users for development, testing, storing and other services (Yang et al, 2011).

Software as a Service (SAAS): The top most layer is the SAAS. Here the applications are already deployed by the providers through the internet. All the users use same software and they are not customized. So when a vendor adds a feature it is available for all the users. Also the SaaS providers need to provide needed software, hardware, network infrastructure, operating platform and others. So this reduces the cost for the users. They just want to pay for their usage. SaaS vendors are responsible for all other works like upgrading the systems, security and maintenance. The users do not want an upfront cost for or investment for database, servers and lice Software. And another important fact is that SaaS is much more closely related with other service delivery models (Yang et al, 2011).

SAAS Maturity Levels

SaaS is comprised with sophisticated technologies and application frameworks which has resulted in giving more valued services for the end users. There are many types of modern components which are used to enhance the usability of the SaaS as well as to reduce time and cost which is spent to convert traditional software in to a SaaS application. So Microsoft has identified that SaaS architecture can be categorized into four different types of maturity levels (Hancheng, 2009).

Ad-Hoc /Custom : This is the first level and it has no maturity. Here each customer is having a customized SaaS application which has been hosted on the server. So the application is running its own instance in the server. Low development efforts , low operating and maintaining costs are the advantages when normal applications transfer to SaaS can have through consolidating administration and hardware (Yao. 2015; Mahesh, 2014).

Configurability: This is the second SaaS maturity level and it provides users with a flexible programs to recognize different users via one application as a result of configuring the metadata. Metadata helps to identify different users and their needs so that cloud providers are able to maintain a general core code of the application without considering the users and their requirements. This eases the burden of the vendor. In addition to that it also helps to allocate resources like application or software for the users' demands (Yao. 2015; Mahesh, 2014).

Multitenant Efficiency: This is third level of maturity and this is formed by adding the multi-tenancy for the second level. What is happening here is that through one program instance it can serve all of the users and also it still can identify each individual users and their demands separately (Yao. 2015; Mahesh, 2014).

Scalable : This is the last maturity level and it uses a multi-tiered architecture. Locking duration is optimized and shared resource pool is used to make maximum usage of the available resources. So the system capacity can be dynamically raised or deducted through addition or removal of servers (Yao. 2015;

Mahesh, 2014).

SAAS Architectural Levels

There are five levels in the SAAS architecture. They are user layer, distribution layer, application later, data access layer and network layer.

User Layer: This is the top most layer. It is comprised with the web browser, user interface a client software. This software is very easy to find and download to their machines. Users can use these gateways to enter into applications. There are also components called as user process components which supports in synchronizing the user interactions. There is also a web site to show user about the payments. Interface in which users can choose extra services as they want (Hancheng, 2009; Yao, 2015; Satyanarayana, 2012).

Distribution Layer: This is the second layer which is placed between user layer and the application layer. The application instances on the application server have to distribute to the users in an efficient and effective way. But there can be instances where one server group get overloaded with request while other server group has a lot of resources remaining. So what the distribution layer does is that it handles the load balancing between application servers. Distribution layer is also responsible for transferring and replicating relevant data to another place to make data redundant and available.

Another goal of the layer is to optimize the usage of resources and improve the response time. There are also financial and security solutions available in this layer as SaaS is more related with business models. Therefore it has a metering and a billing system which calculates the total fee and pass the results through the billing system as a user readable invoice in order to support financial models (Satyanarayana, 2012; Hancheng, 2009).

Application Layer - Http request which are sent by users are managed here and processing of these requests with the business logic are also performed. There are some components which perform several tasks separately. Customization /personalization components make the user aware of configuration options which in turn affects for the performance and view of the application. In addition to that there might also contain integration servers which are specially designed to make the main functionality of applications easier when it combines and integrates with an existing system. There are also some other services which are provided by the application layer such as clustering for data redundancy (Yao, 2015; Satyanarayana, 2012).

Data Access Layer: Data segregation and processing them is performed through this layer. Well structure database models like SQL databases and object databases or unstructured file systems are used to store data here. At the time of transmitting data across different servers it provides security and data integrity also (Yao, 2015).

Network Layer: High security should be maintained when data is transferred across the SaaS providers'

internal network as well as external network. Internal networks are highly ensured with the security protocols and their own set of policies. External network basically includes internet and more precisely a model where data flows through the network according to the relevant protocols. Internet is also connected with mobile networks to support the data flow of networks (Yao, 2015).

There are three main components in this layer. Communication servers make sure that communication takes place when it faces different types of protocols among users. Network monitoring component check network traffic regularly to recognize where data may not transfer successfully. Network logging component keeps track of in and out network traffic and when a particular part is accessed by a host it records the data about the context and protocols associated with the scenario. Instances of tracking down the potential malicious host and blocking them to prevent the access to servers can be done by the network logging (Yao, 2015; Satyanarayana, 2012).

Security Layer: This is the final layer of the SaaS architecture and it is very essential for all other layers. This provides the facilities of authentication and authorization, log system and monitoring solutions to other layers. All the security needs of layers are carried out by this security layer. SaaS users can decide whether to implement these security measures to a specific layer or even for all layers thinking about the requirements of them. This layer also have the mechanisms for the user support where it contains different security policies or specialized user requirements (Yao, 2015; Satyanarayana, 2012). The layers which are described above are not must in every SaaS application. But it is needed for a more mature, secure and reliable application where it helps for a smooth and effective business functions.

Benefits of SAAS

SaaS has been able to establish a prominent place in the business world though it has a short history. It is the best-known branch of cloud computing as it promises and delivers the users with many potential benefits. Enterprises didn't take SaaS in to much consideration earlier, but later this attitude was changed dramatically with SaaS's affordability and the convenience (Yao, 2015) . In traditional software systems people had to face with many issues like high initial costs, licensing and training. Hence SaaS promised much easier cheaper and speedier implementation enterprises were intrigued and moved into SaaS by considering it as a strategic alternative to on-premise application (Levinson, 2007). As a result SaaS has grown far beyond its early stages which included areas like Human Resource and Customer Relationship Management technologies and it has moved to broad range of applications for business and IT. The benefits of SaaS can be identified as follows.

Cost Saving : This is a major reason for people to embrace SaaS applications over the traditional software. SaaS excludes a lot of costs and provides its services much cheaper. SaaS is known as pay-as you-go software. Because they allow their users to some amount in each month with respect to their usage. SaaS implementation is also not expensive and it does not need additional infrastructure like hardware. The cost types are as follows (Yao, 2015). First one is the implementation cost of SaaS and it is comparatively very low with on-premise software. in traditional software people have to pay a huge amount to obtain license but here that is not needed. Also need of heavy infrastructure like hardware components and other supporting software is not occurred in SaaS. SaaS is often come up with reduced customization capabilities which in return reduce the costs. Cost needed for training the people is also much reduced than other software (Herbert et al, 2009).

Other one is the recurring cost and it is simply the subscription cost. People can pay for the time period they use it, the amount of resources they use or even as per transactions they make. SaaS is much more popular among people due to this reason. In traditional software they have to pay a huge amount in purchasing and even after that though they do not use it on regular basis. So the pay-as-you-go is much fair for the users and it attracts more customers. Also firms have other recurring costs such as costs for integration tools or other add-on-technologies. Firms also have people costs like admin and support costs, training costs. With the usage of SaaS these costs reduced to a great extent. However these can be varied with the type of application, size of deployment and the organization's IT skills (Mahesh, 2014).

Final type is the upgrading cost. SaaS providers take care of maintenance and security of applications. So the users do not want to expend on those attributes. They also offers seamless, automatic and frequent upgrades on the charges they get for subscription. They have specially reduced testing and training costs as these upgrades are offered more frequently and incrementally than traditional software (Herbert, 2009; Yao, 2015).

Fast Deployment : SaaS is very fast in installation and addition of users. The need of having their own hardware and associated testing and ready-to-go preconfigured solutions is removed in SaaS.in SaaS the purchasing cycles are also short where t the organizations are made easy to deploy incrementally and offers monthly or annual contracts. SaaS also supports in long run as well as in short run where they provide easy measures to add new users, new suites, and new functionality (Mahesh, 2014; Herbert et al, 2009).

Better User Adoption : As the firms record it is also seen that the adoptability of users is also high. In traditional software firms complain that they suffer from low user adoption rates although they invest a lot in end user training and user interface designs. But in SaaS applications the providers have increased the user friendliness. They have made use of familiar web programs to users and made them more natural and more intuitive. SaaS applications are also cable of delivering usage reports so that the firms can identify gaps in user adoption. Then they can eliminate the identified gaps or address the problems with a proper solution (Mahesh, 2014; Herbert et al, 2009).

Reduced Technical Support and Training : Unlikely in traditional software the support needed for the SaaS applications are very low. Earlier, firms had to pay for third parties in order to get IT services. But those have been eliminated and the technical support staff which performs training, bug fixing, patching are also eliminated completely in the SaaS environment because those are already done by the service providers.

The support given by SaaS is also useful. They enhance the usability through built-in tutorials and help files with standards (Herbert et al, 2009).

Upgradeability, Scalability and Accessibility : As mentioned above the service provider deals with the updates which incurred with software and hardware which in return unload a huge burden from the firm. This helps to get the latest versions of upgrades and the systems are always up to date. SaaS is more flexible towards scaling. Firms can add more users and more functions. It will only adjust the monthly subscription as required. The required resources to access the SaaS are very few. It only needs a browser and an internet connection. So this has led SaaS to be available in on a wide range of desktop and mobile applications (McLellan, 2013).

Resilience: The security issues and threats from external disasters like flood or fire to physical premises where the systems are located can happen at any time in traditional software. So they will have to face problems of losing data. But in SaaS as the data resides in the cloud service provider's datacenter it will not be problematic. Firms can receive their back up easily from any location by connecting to the internet (Herbert , 2009; McLellan, 2013).

Security Challenges Faced by SAAS

SaaShave a huge market in the business world by providing benefits and convenience to the users through to its high performance. However when the usage is increased and additional functionalities are added, SaaS is facing with many challenges. Sometimes unawareness of clients on technical security and other security measurements on SaaS will lead for many inconveniences. Hence clients may doubt on reliability and safety of SaaS. However there are some issues which are really bothersome and confusing. They may arise due to some mistakes of the security aspects and deployments. Clients believe that service providers will protect their data and maintain it properly. Nevertheless clients should be well aware on possible security risks therefore they could take necessary measures beforehand (Yao, 2015).

Clients should be well aware of the correct security measures and how to come with agreements with service providers so that they can protect their data. SaaS vendors have to provide solutions to solve the issues which are usually face by common communication systems together with issues inherited by cloud computing platform. Frequently the service providers host their applications on their servers or sometimes they deploy it on a third party provider such as Amazon, Google. (Thiwari, 2014) SaaS security issues can be grouped under 3 main categories as follow (Yao, 2015).

Security of Data

This is an essential aspect for the users and it mainly concerns with the protection of data in databases. Threats may come from the intentional unauthorized people as well as unintentional access by authorized users. Data is placed in a database and transmitted through the internet and mobile network. Therefore data which is related to an enterprise resides outside their premises. Hence, SaaS vendors must ensure and inform the clients about their safety measures and cautiousness in managing data. Data security issues can be described as below (Yao, 2015).

Storage of Data: Data is stored in a database. SaaS providers must separate each users' data and prevent seeing individual data to others. Various users' data may be stored in the same server or in various instances are made on the same server due to the multi-tenant architecture and virtualization. Therefore if one instance surpass with a malicious attack other instances are also at a danger of being attacked (Yao, 2015, Thiwari, 2014).

Also service providers make duplicate copies of data to make sure the redundancy and availability of data. They make copies and send them over country boundaries. This makes data to be in risk and data can be exposed to other external parties. Legal actions are taken in some countries to check the data which crosses the boundaries. They will check in and out data through them. This is a huge threat to the confidentiality of data. Another aspect is that if the user wants to resign from SaaS applications all of his data must be deleted from the storage. But it may not fully destroyed as data is duplicated on several places and service providers may forget the copies which are available on multiple locations and not connected with the system directly (Yao, 2015).

Accessibility of Data: Access to the data is controlled as data could be breached within the organization and outside of the organization. Sometimes inside trusted employees may cause data loss or leakages (Patel, 2014). Therefore the providers must ensure only the privileged people are accessing the data. Each user is defined and they are enlisted by looking in to their capability of accessing various levels of data. Some organizations are having special policies to settle with these issues. SaaS providers also should compromise with these policies and incorporate them to their access policies (Yao, 2015; Thiwari, 2014).

Integrity of Data: Data must be guaranteed from deletion, modifications from unauthorized intruders and it should be transmitted securely from one destination to another. Service providers should maintain the correctness and transparency of data and data always remains actual throughout its entire life cycle. When data is transferred from one database location to another as well as when data is entered to database human errors could occur. Other situations like natural disasters, software bugs, virus and hardware crashes may also affect to the integrity of data(Yao, 2015).

To protect from these integrity issues service providers should arrange the data to the formulated syntax in the database and prevent invalid data inputs. When the transactions occur at one place data should be updated other places as well. Atomicity, Consistency, Isolation, and Durability which are collectively known as ACID properties should be maintained to assure the integrity of Data.(Thiwari, 2014) As an overall idea SaaS providers should maintain integrity of data in order to tell what has happened to any data item at anywhere(Yao, 2015).

Backup and Recovery of data:SaaS vendors should take care if anything happen to the data. Data can be lost because of natural disasters, hardware failures and corruption of data. SaaS users don't have backup facilities and they depend on vendors for backup and recovery. If anything happens to the data vendors should take countermeasures and recover full files. Following strong security mechanisms like encrypting helps them to protect data from frauds an accidental thefts (Yao, 2015; Thiwari, 2014).

Availability of Data: Data should be offered to users at any given time without any difficulty or interruptions. They should also maintain quick response time and effective results. SaaS providers should use effective load balancing methodologies to provide data to the users (Thiwari, 2014),(Patel, 2014).

Security of Application

This sector describes the utilization of software or hardware to overcome harmful or unexpected actions. Security of the SaaS can be in risk through the applicationit self. Therefore vendors should guarantee that the attackers don't get an opportunity to approach to the administrator and make unwanted changes. The issues regarding application can be arisen at some levels of its design, developments, implementations and access(Yao, 2015).

Design Flaws of Software: Software designs of SaaS is different from traditional software with the architecture, user interface and different APIs. A SaaS developer who is familiar with developing isolated and single applications has to overcome the barriers associated with the multi-tenant architecture. Therefore it requires a technology to maximize the sharing of resources among different users while differentiating data of each user (Yao, 2015). As SaaS is heterogeneous APIs are more essential parts in the design. Programming languages need to support the front end and back end of the application with the APIs' ability of interoperability. APIs must be strong and solid because poorly designed APIs will cause threats and attacks (Thiwari, 2014).

Authentication and Authorization: Authentication means the users are verified before logging to the systems to check whether they are the permitted people. Therefore SaaS users such as organizations should remove accounts if employees left the organization and give new user accounts and passwords to the new employees (Thiwari, 2014). In authorization it entrust responsibilities and give permission to different access levels for the users. Hence different roles are made and users are validated to check his accessibility. People who will have right to access will only get to enter in this mechanism (Patel, 2014), (Keiko et al, 2013).

Malware: These are harmful software or code parts that will change or destroy the user details without user's grant. Therefore users should make precautions actions in the situations like downloading application software. Users should have proper security measures installed such as firewalls, virus guards and etc. If not their valuable data may face to security risks (Yao, 2015).

Security of Deployment

There can be different threats in deploying SaaS applications. Virtualization technology is used by SaaS vendors and they create different instances on hardware therefore each instance has a guest Operating System (OS) (Keiko et al, 2013) .Provider has one instance running for every user. Each user get a unique experience and unique set of features. Further it is transparent to the end users that their application instance is being shared among many users. Virtualization approach saves the usage of resources and optimize server allocation. At the same time weaknesses in virtualization may affect to the security of SaaS. Two aspects of SaaS deployment security can be identified as follows(Yao, 2015).

Vulnerabilities in the Virtual Machine: A machine called as Hypervisor is available where number of Virtual Machines (VMs) having separate OS are hosted. Attackers reach to these hypervisor across a running instance hosted in it(Keiko et al, 2013). Also attackers can interfere to the in and out data flow as well as CPU utilization and even they can close any hosted instances. In VM environment resources such as CPU, RAM and hard disk are shared among instances. Therefore if one instance acquire many resources, requests from other users may throw back due to lack of resources(Yao, 2015).

Vulnerabilities of Virtual Network: Many hypervisors let VMs to connect to the outside physical environment by having Virtual Networks (VN). However virtual networks in SaaS may cause security issues than normal physical networks. For an example attackers can forge IP address which is similar to other VM in the network. Therefore VMs traffic will be redirected(Jensen et al, 2012).

Emerging Trends of SAAS

Users are the product changers of any field. Any business owner must know about the requirements of customers and change their strategies accordingly. Similarly SaaS also have identified some drawbacks of their existing methodologies and they are moving into new trends. SaaS been engaged in various innovations to develop their applications. Following are some of the emerging trends that has been entered to the market recently (Gohring, 2014).

Vertical SaaS Applications are one such emerging trend in the business world. It is a type of SaaS application which is designed specially target group of customers like insurance, retail, manufacturing, health care and etc. Textura (TXTR), Veeva systems (VEEV) are examples for such applications (Ding, 2014). Vertical SaaS is focusing on all business processes from Customer Relationship Management (CRM) to Supply Chain Management (SCM) in a specific type of customer base. But in horizontal SaaS it focuses on a specific functional area like finance or sales for every customer type. Therefore it gives one software which will fit to all type of customer groups while vertical SaaS targets a homogeneous market (Manninen, 2015).

Most of the vertical SaaS providers are startups. They focus on a small market or a niche market. Then they go deeply through it and produces better customized products which will be more specialized to a selected

customers. This will full fill customers' requirements and those customers do not need to individually customize the products. It is very easy to create products for specialized group and therefore it is inexpensive compared with horizontal SaaS. This will also attract new customers. Vertical SaaS results in creating business solutions much faster and it saves money as well. They provide strategic solutions for customers by identifying their demand. Therefore this results for higher market growth and higher revenue. Customers also find easy to adapt to these systems as they are more user centric (Rouse, 2015).

Vertical SaaS providers give better products and high quality solutions as they have a narrow focus. There are many businesses which use traditional technologies and have more manual processes. Therefore they are reluctant to adapt to normal SaaS environment due to lack of support provided. But through vertical SaaS those types of customers are also targeted. If few business firms adopt to these kind of application it will spread in entire niche market. Then it will cause less cost for sales and marketing as well. Through these customized applications firms can collect specific data and use them for business analytical purposes and strategic decision making. Existing SaaS systems do not provide precise or relevant data and they do not have needed infrastructure for collecting them. Vertical SaaS also helps to understand common problems faced by the selected customer group and it helps to develop solutions according to the preference of them. Due to all above reasons Vertical SaaS is becoming more popular today (Rouse, 2015; Poulos, 2015).

Another technology which was emerged recently is Salespod. It was introduced by the collaboration of SaaS service provider known as Sales force and HP. (Hewlett - Packard). This is an alternative solution for multi tenancy where users have to share a common instance of application while data is kept separately. This model provides the companies to have their own separate infrastructure which is connected to a single server side instance. There are fifteen computer pods spread over datacenters and every pod has a huge number of customers with multitenant services (Kanaracus , 2014; Deutscher, 2014).

This product is built to cater the customer needs of high security and transparency. Some customers were claiming for more personalized usage and safety of data.in order to meet those demands Salespod has been developed. It is more of a hybrid solution which will pave the way for many innovations in the future as well. This product is basically aimed at larger customers who are not satisfied with the current facilities provided. Therefore it will be very useful for the customers and will be able to eliminate the drawbacks of the SaaS to some extent (Henschen, 2014).

Discussion

SaaS is a service centric software model which delivers software to the end user through the internet. Users can use the software and pay as for their usage. SaaS uses multi-tenant architecture which in turn helps to deliver many positive impacts on the user. Therefore SaaS provides many benefits to its users such as cost saving, easy adoption, easy upgradability and etc. SaaS providers take care of maintaining and utilization of resources efficiently and they always try to meet the demands and challenges of the business world. Due

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to these reasons most of the conventional software has been replaced by SaaS. Although there are many advantages in using SaaS it still have some practical issues which have to be solved related to privacy and security. Those security challenges make SaaS vulnerable for data loss and safety issues. Therefore SaaS vendors have to face these challenges successfully so that they can retain their position in the business world. To deal with higher customer expectations new trends like Vertical SaaS and Salespod are introduced by the service providers and they promote the usage of SaaS further.

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The impact of transformational leadership in improvement of the

organizational capability

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Abstract

Transformational leadership has a major impact on the improvement of organizational culture and success. It affects change in cultural characteristics of the individual and improvement of human achievements in all areas, thus creating a long-term positive approach of a person. It results in positive transformation of a person and improvement of its potentials.

The transformational approach has a capacity to make significant change both in individuals and in the organization through adaptation, expectations, aspirations, perceptions and values. Such an approach is based mostly on leader's personality, his character, vision, the power to accept the challenge and on his own example.

Transformational leaders are focused on the "common good" instead of their individual "power bases", they are broad-minded and respect the interests of their followers. With such leaders people are willing to create and innovate and to work harder than expected,.

The paper studies some views on transformational leadership based on charisma, innovation of the companies, producing success and building personalities with durable and unperishable values. This is empirical research on the image of organizations formulated through the statements of managers and employees and presented through tabular, graphical and calculated correlative values.

Key words: leadership, transformation, charisma, innovation, followers, inspiration, creativity, teamwork

Introduction

In modern life and work the companies are facing new challenges and changes, to which they must respond in a dynamic and inventive way, mobilizing all available resources in order to maintain their competitive advantages, but they also have to find ways to mobilize their creative potentials to the maximum. Companies need leaders who know how to inspire their followers, to realize their vision and to make the necessary changes willingly, with enthusiasm, as a part of the team that is fully cooperative and committed to the common goal.

The transformational leader is a role model for his employees, who stimulates them to undertake individual initiative and responsibility, to identify their strengths and weaknesses and to constantly work on their personal improvement and innovation.

The transformational leader is distinguished by personal integrity, trust of the followers, creativity, team orientation, gratitude, learning, responsibility, recognition, etc. Through personal examples and acts he changes the perceptions and expectations and his infectious enthusiasm stimulates followers to exceed normal levels of performance. Transformational leaders, through their personal example, inspire and encourage human resources in the company for their most efficient engagement.

Moreover, they have the potential to manage changes in organizations and their employees in a way that ensures growth, risk management, and minimization of negative effects.

Transformational leadership

Transformational leadership inspires the employees to observe things from a new perspective, to realize the vision of the company, to develop their potentials and to fulfill their personal goals

through achieving the objectives of the company.

Successful transformational leader prefers clear and attractive visions, creates strategies for achieving the goals by articulating and promoting the visions, his actions are characterized by courage and optimism, he uses the success achieved in earlier stages to gain respect and trust and to increase the optimism among followers, he uses symbols to highlight the key values, creates and modifies positive cultural forms (slogans, symbols, etc.), promotes positive changes, etc⁴.

Transformational leadership increases the incentives for mutual co-operation, turning followers into leaders in their own field of work and leaders into ethical mediators and initiators⁵.

Good transformational leaders inspire confidence in others and transferring this confidence they feel fulfilled. They have a special power to transform both managers of lower levels and followers into persons who will share their preference of durable values. Transformational leaders are focused on "the common good" rather than on their own power bases⁶.

Practicing transformational leadership the leaders become broad-minded and respect the interests of their employees. With such leaders as role-models people are stimulated to work harder than expected. They also show a sense of trust, respect, loyalty and admiration⁷. This process is in line with nature and followers develop different ways to change the environment, improve the current practice and provide mutual support for the team.

Bass proposed the following aspects of transformational leadership, which distinguish it from other leadership concepts⁸:

- Charisma and good behavior toward others - The leader acts as a role model for other employees. They have to admire, respect and trust him. He puts the interests of the employees ahead of his own and behaves in accordance with ethical codex.

⁴ Yukl, G., 1999. An evaluation of conceptual weaknesses in transformational and charismatic leadership theories. Leadership Quarterly, 10, 285-305; http://dx.doi.org/10.1016/S1048-9843(99)00013-2

⁵ Burns, J.M. (1978) Leadership. New York. Harper & Row

⁶ Sarah Simpson.,(2012). The Styles, Models & Philosophy of Leadership, Ventus Publishing ApS, p.9

 ⁷ Bass B. M. and Avolio B. J., (1993). Transformational Leadership and Organizational Culture, Public Administration Quarterly, 12,113-121.
 ⁸ Bass, B.M. & Avolio, B.J., 1994. Improving organizational effectiveness through transformational leadership. Thousand Oaks, CA: Sage Publications

- Inspirational motivation - The leader must always put new challenges to his followers. He presents clear and important goals in a simple way. He builds a strong team spirit, stimulating dedication, optimism and enthusiasm.

- Intellectual stimulation -The leader is always questioning his goals. He approaches the old ideas in a new way and reassess the previous ways of solving the problems. The leader is stimulating careful approach to the problems, rationality, innovation and creativity and he supports intellectual efforts.

- Individualized consideration - The leader pays attention to each person as a specific individual. He cares about the individual followers' needs, achievements and developments and creates opportunities for additional learning. He avoids direct control, supervision and public criticism of followers and accepts the diversity among people.

The goal of transformational leadership is to "transform" people and organizations in a literal sense: to change them in their hearts and minds, to develop a clear and appealing vision, to confirm the objectives, to adjust the behavior to the beliefs, principles and values or, in a word, to make changes that are real, permanent, essential, and evolving. This can be achieved by transformational leader who has a vision, initiative, patience, respect, persistence, courage and faith in oneself.

According to Tom Peters⁹, key characteristics of a successful leader are the following: honesty, competence, modernity, inspiration, fair-mindedness, persistence, imagination, creativity.

Followers of transformational leaders feel trust, loyalty, admiration and respect toward the leader and they are motivated to do more than they originally expected to do.

According to Bass, leaders transform and motivate their followers in a way that¹⁰:

- 1) make them more aware of the importance of task outcomes,
- 2) induces them to transcend their personal interests for the sake of the organization or the team, and
- 3) activates their higher-order needs.

In transformational leadership people describe their ideal leader as a role model with whom they want to identify¹¹. Transformational leadership as a process by which leaders take action to try to increase the awareness in their associates of what is right and important, to raise their motivational maturity and to move them to go beyond their own self-interests for the good of the group, organization, or society.

The role of transformational leaders

Transformational leaders are the main factor for transforming the company in organization with better performance. The success of the transformational process depends on their attitudes and values. Some of the key characteristics of transformational leaders are¹²:

⁹ Tom Peters,2005. Leadership (Essentials), DK Publishing.

¹⁰ Bass, B. M. 1996. A new paradigm of leadership: An inquiry into transformational leadership. Alexandria, VA: US Army Research Inst for the Behavioral and Social Sciences.

¹¹ Robert N. Lussier., Christopher F. Achua., Leadership, (2010): Theory, Application, and Skill Development 5th Edition

¹² Marlane C. Steinwart, Jennifer A. Ziegler, 2014. Remembering Apple CEO Steve Jobs as a "Transformational Leader": Implications for Pedagogy. Journal of Leadership Education DOI:10.12806/V13/I2/R3

- charisma and personal example,
- promotion and support of innovation,
- conviction that they make right decisions toward positive change of the organization;
- understanding and trust in people and care for the needs of the followers;
- believe in true values and act in accordance with a core set of values;
- lifelong learning and profound analysis of practical situations,
- flexibility and openness to the contemporary achievements in science, recognition of positive values,
- strong power of observation, inclination toward disciplined thinking and analysis of problems
- visionarity and belief in positive aims, etc.

One of the key qualities of the transformational leader is his charisma. Without charisma one cannot become transformational leader. This trait, however, is not enough for the leader to carry out the transformational process.¹³

Charismatic leaders are able to arouse strong emotions among followers and identification with the leader, but it can be also a trait of autocratic leadership, whereas the aim of the transformational leadership is not only to secure loyalty, but also attachment of the followers to the idea of their leader.

Empirical research

The aim of the theoretical and empirical research is to look at the theory and practice and to perceive the situation by applying transformational leadership in the research firms.

The main hypothesis in this paper is the assertion that: transformation leaders are a key factor in transforming the organization and the employees into higher value entities. The methods used in this research are: analysis, survey and statistical analysis, processing and calculation of data. The survey as a method of research was conducted by formulating questionnaires with standardized questions for the managers and for the employees, divided into several groups of statements. The collected data is statistically processed, which enables the ranking of data and their presentation through a tabular and graphical display, in order to provide more detailed conclusions from the conducted practical research.

Although the questionnaires were distributed to 150 managers and employees, however, 31 managers and 102 employees answered all questions.

In the empirical research, the x^2 -test and the coefficient of contingency (C) were used, in order to understand the relevance of the statements of the examined managers and employees. As one of the most commonly used tests, the x^2 -test was used to examine the differences between the group variance of the investigated and theoretical frequencies.¹⁴

Below is a tabular and graphical presentation of the received and processed data from all the questions that are the subject of this research, as well as their interpretation.

¹³ Timothy A. Judge, at all, 2006. Charismatic and Transformational leadership.Organisationpsichologie 50 203-214.

¹⁴ Miceski Trajche, (2009) Health statistics and data analysis, University of "Goce Delchev", Shtip, page 154-191

The first question was: Does the manager distinguished himself with charisma and is he an example for the employees?

Tahla 1-T	ahular nr	esentation o	f the answers	of the ex	amined m	nanagers e	ofter the	first	nuestion
Table 1. 1	abulat pro	esentation o	i the answers	of the ex	kammeu n	nanagers a	mer me	111 51 0	question

Question 1	Answer	Manager		Employees			
		Ν		Ν			
		%		%			
Does the manager distinguish himself	Yes	25		54			
with charisma and is he an example		81		53			
for the employees?	No						
		1		12			
	No answer	3		12			
	Total	5		36			
		16		35			
		31		102			
		100		100			
Calculated value of X ² = 18,329							
C = 0,290							

The answers to this question are shown in Graph 1:

Question No. 1.	Does the manager distinguish himself with charisma and is he an example			
for the employees?				
Managers		Employees		



Figure 1. Graphic presentation of the answers of the examined managers after the first question

From the tabular and the graphic display, it can be seen that 81% of the managers on the first question in the surveyed companies consider that they have real capabilities such as: charisma and that they are an example for the employees, 3% of them answered negative, while 16% remained unanswered.

While 53% of the total surveyed employees believe that their managers are characterized with charisma and that they are an example for the employees, 12% have declined negatively, and 35% have remained unanswered.

The calculated value of the X^2 test for this question is 18,329 which is greater than the tabular value of X^2 of 5,991, which can be concluded that the answers of the managers and the employees do not match with this question. The coefficient of contingency is 0.290 indicating a very weak interdependence between the examined variables.

The second question was: Does the manager inspire and motivate the employees?

The answers of the examined managers and employees are shown in the table and in the graph below.

Question 2	Answer	Manager	Employees	
		N	N	
		%	%	
Does the manager inspire and	Yes	28	51	
motivate the employees?		90	50	
	No			
		1	12	
	No answer	3	12	
	Total	2	39	
		7	38	
		31	102	
		100	100	
Calculated value of X ² = 38,184				
C = 0.400				

Table 2. Tabular presentation of the answers of the examined managers after the second question

The answers to this question are shown in Graph 2:



Graph 2. Graphic presentation of the percentage representation of the answers of the managers and the employees on the second question.

From Table 2 and Graph 2 it can be seen that 90% of the managers, and 50% of the employees share the same opinion. On the same question, they thought otherwise, i.e. 3% of the managers and 12% of the employees answered negatively. 7% of the managers and 38% of the employees remain unanswered.

The calculated value of the X^2 test for this question is 30,184 which is greater than the tabular value of X^2 of 5,991, whereby the answers of the managers and the employees to this question do not match. The coefficient of contingency is 0,400 indicating very weak interdependence between the examined variables.

The third question: Does the manager approach the problem solving carefully, and encourages inventiveness and creativity among employees?

Table 3. Tabular presentation of	the percentage representation	of the answers	of the examined
managers after the third question			

Question 3	Answer	Manager	Employees	
		N	N	
		%	% %	
Does the manager approach the	Yes	29	55	
problem solving carefully, and		94	54	
encourages inventiveness and	No			
creativity among employees?		0	10	
	No answer	0	10	
	Total	2	37	
		6	36	
		31	102	
		100	100	
Calculated value of X ² = 42,239				
C = 0,418				

The answers to this question are shown in Graph 3:

Question 3. Does the manager approach the problem solving carefully, and encouragesinventiveness and creativity among employees?ManagersEmployees



Graph 3. Graphic presentation of the percentage representation of the answers of the managers and the employees on the third question.

The table and graph show that out of the total number of 31 surveyed managers, 94% answered positively that the manager (leader) with a personal example motivates and inspires employees towards positive changes in the behavior and operation of the firm, and out of 102 of the total surveyed employees, 54% share the positive opinion on this question, while 0% of the surveyed managers answered this question negatively, ie with no, and 10% of the surveyed employees answered in the same way or negatively. Unanswered remain 6% of the surveyed managers and 36% of the surveyed employees. The calculated value of the X^2 test for this question is 42,239 which is greater than the tabular value, whereby the answers of the managers and the employees to this question do not match. The coefficient of contingency is 0,418 indicating very weak interdependence between the examined variables.

The presentation enables us to see that in the surveyed companies it cannot be said that the transformational leadership is applied, or, it can be concluded that the manager does not approach carefully to solve the problems, and encourages the inventiveness and creativity of the employees.

The fourth question: Does the manager pay attention to the person, treat each individual as a specific individual, knowing the diversity among people?

Question 4	Answer	Manager		Employe	ees	
		N		N		
		IN O(IN D(
		%		%		
Does the manager pay attention to the	Yes	30		49		
person, treat each individual as a		97		48		
specific individual, knowing the	No					
diversity among people?		0		13		
	No answer	0		13		
	Total	1		40		
		3		39		
		31		102		
		100		100		
Calculated value of X ² = 60,416						
C = 482						

 Table 4. Tabular presentation of the percentage representation of the answers of the examined managers after the fourth question.

The answers to this question are shown in Graph 4:



presentation of the percentage representation of the answers of the managers and the employees on the fourth question.

The table and graph show that out of the total number of 31 surveyed managers, 97% answered positively that the manager pays attention to the person, treat each individual as a specific individual, knowing the diversity among people, and out of 102 of the total surveyed employees, 48% share the positive opinion on this question, while 0% of the surveyed managers answered this question negatively, i.e. with no, and 13% of the surveyed employees answered in the same way or negatively. Unanswered remain 3% of the surveyed managers and 39% of the surveyed employees.

The calculated value of the X^2 test for this question is 60,416 which is greater than the tabular value. The coefficient of contingency is 0,482 indicating moderate interdependence between the examined variables. The presentation enables us to see that in the surveyed companies it cannot be said that the transformational leadership is applied, or, it can be concluded that the principles of the transformational leadership are not sufficiently recognized and applied.

From all this it can be concluded that the results of this empirical research show that in most cases, the basic hypothesis that transformational leaders are a key factor in transforming the organization and the employees into higher value entities is not confirmed. It points to the properly selected area of research and directs to greater training i.e. upgrading especially for managers, but also for employees.

Conclusion

Transformational leadership is closer to the prototype of leadership that people have in mind when they describe their ideal leader, and it is likely to provide an example that the subordinates want to identify with. Transformational leadership contributes to greater motivation and performance among followers compared to those of transactional leadership, but the effective leaders use a combination of the two types of leadership. The aim of transformational leadership is to "transform" people and organizations in the literal sense - to change them in the heart and mind; to increase vision, views and understanding; to clarify the goals; to act in accordance with beliefs, principles, and values. Transformational leadership is a process in which leaders undertake activities in which they try to raise awareness among their supporters of what is right and important, to raise their "motivational maturity to move beyond their own interests," for the benefit of the group, organization, or society. Such leaders provide a sense of goal for their supporters, a goal that is beyond the simple exchange of rewards for the effort.

Transformation leaders are proactive in many different and unique ways. These leaders are trying to optimize the development, not just the performance. Development involves the maturation of ability, motivation, attitudes and values. Such leaders want to raise the level of maturity for the needs of their supporters (from security needs, to the needs for achievement and their own development). They persuade their supporters to strive towards a higher level of achievement, as well as to higher levels of moral and ethical standards. Through the development of their supporters, they optimize the development of their organization. The high performances of the supporters build high performances of the organizations.

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Detection of Isolated Vibration Spectrum Patterns Generated in Hull and Shafting Lines Which Result Shipboard Faults

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Abstract

The origin of shipboard hull vibrations is dominantly determined by vessels propulsion system, main machinery, auxiliary systems, pumps, breaking of the waves at the ship hull, etc. When the ships are classified on various sizes and limitations, they demonstrate multiple characteristics of vibration signatures mainly based on the functionality of main machinery and ships' hull. The vibration signatures generated from hull is a clear representation of the ships health and crew habitability.

The paper is focused on to a case study that the hull of a naval vessel which had undergone a major repair was inspected for suitability for further use in terms of vibration and habitability. The transferred vibration signature of the vessel was analyzed using vibration spectra in machinery and hull aspects. The measuring was done simultaneously with multi-channel measurements of the vessels vibrations at few characteristic positions.

Sea trials at following variable conditions had been carried out onboard the selected vessel. Sea State: 2-3; Loading Condition: Half Load; Wind Condition: Moderate< 15 knots; Sea Direction: Ahead, Astern

Keywords: Shipboard vibration; vibration spectrum; habitability; vibration analyser

1. Introduction

Shipboard hull vibration phenomena are caused mainly by the following sources of excitation:

- a. the propeller (periodic vibration)
- b. engine and auxiliary machinery (periodic vibration)
- c. effects of the sea (random vibration)

Mainly the propulsion package of the ship (main engine, gear box, shafting and propeller) creates almost 85% of the shipboard vibration, which is invariably undesirable for ship and crew. But, a complete counter action or elimination is not at all possible. A comparative reduction to keep parameters in acceptable range is always possible with introduction of a proper vibration monitoring and damping system, which is also a great challenge. Early detection of developing hull and shafting problems will not only save money but
will enable the crew to avoid any catastrophic failures which might result a complete shutdown in system.

In this particular instance the vessel was examined for further use based on vibration levels as per ISO 6954: 2000 standard and vibration spectrums.

2. Methodology

Vibrations of the vessel are analyzed using Fast Fourier Transform (FFT) algorithm in two frequency bands, the first from 0 to 200 Hz, and the second from 0 to 2 kHz. Taking into account the overall linear dimensions of the vessel, low frequency range of the vibrations is of particular interest, and therefore the limits of the above frequency bands are defined. Particular interest is in the low frequency band, which is defined from zero to 200 Hz. Vibrations were measured during the movement of the vessel in the measuring points defined.

2.1 Vibration Analyser and Software

The trial team used 02 Nos vibration data analysers (Frequency Range: 0 - 40,000 Hz) integrated with supported software system. The averaging used is 5 times and FFT uses Hanning window method for data filtering. One analyser is having two channels and the sampling frequency for each channel is 102.4 kHz.

2.2 Measurement Conditions

Measurement data is obtained, during performance sea trials of the ship. The data was recorded at following uniform and favourable measurement conditions:

- a. Free-route test on a straight course: The ship sailed on a straight course with minimum rudder deflection. (i.e. +/- 2 degrees Port to Stbd rudder angle)
- b. Constant representative engine output; Generally the power output on the propeller shaft(s) shall correspond to contractual normal seagoing condition, or at least 85% of maximum continuous power available on the propeller shaft(s). All other machinery was run under normal operating conditions during the tests.
- c. Sea state 3 or less
- d. Full immersion of the propeller
- e. Water depth not less than five times the draught of the ship

2.3 Measurement Procedure (As per ISO 6954: 2000)

a. Measurements were recorded in all three directions at a minimum of two locations on each deck. At other locations, measurements are only required in the vertical direction.

b. The combined frequency weighting curve according to ISO 2631-2 was applied to all measurements irrespective of their direction.

c. The frequency range evaluated was 1 Hz to 10000 Hz. (Analysed separately in low, medium and high frequency ranges)

d. The measurement duration was above 1 min. for all machinery locations. For hull locations measurement duration of at least 2 min is required.

e. The result of each measurement shall be the overall frequency-weighted r.m.s. value.

A similar procedure is applicable for the frequency weighting of velocity spectra. The highest value in any direction could be used for the evaluation of habitability in another study.

2.4 International Standards Followed

Following international standards have been adhered during the data recording and conduct of sea trials.

- a. ISO 10816-1, "Mechanical vibration-Evaluation of machine vibration by measurements on non-rotating parts, Part 1: General guidelines".
- b. ISO 6954: 2000, "Guidelines for the measurement, Reporting and Evaluation of Vibration with regard to Habitability on Passenger and Merchant Ships"
- c. ISO 20283-2: 2008, "Mechanical vibration-Measurement of Vibration on Ships, Part 2: Measurement of Structural Vibration"

Following rules and classifications published by Det Nortske Veritas (DNV) in "Rules for Classification of Ships" July 2004 (Revised in July 2009) also considered during the data recording and conduct of sea trials.

- a. Part 6 Chapter 11 Hull Monitoring Systems
- b. Part 6 Chapter 15 Vibration Class

2.5 Locations for Data Recording

		1
Sr No	Location	Direction
Machinery	Locations	
1	Gear Box Free End	Vertical Horizontal Axial
	(G/B F/E)	
2	Gear Box Drive End	Vertical Horizontal Axial
	(G/B D/E)	
3	Main Engine Free End	Vertical Horizontal Axial
	(M/E F/E)	
4	Main Engine Drive End	Vertical Horizontal Axial
	(M/E D/E)	
5	Self-Aligned Bearing	Radial Oblique
6	Plummer Block	Vertical Horizontal Axial
Hull Locat	ions	
7	Rudder Top (P/S)	Longitudinal Transverse
8	Steering Compartment (P/S	Vertical
	04 positions)	
9	Mast	Vertical Longitudinal Transverse

Table 1. Locations onboard Ship

2.6 Loading Condition of the Ship

Tuble 2. Louding Condition						
Sr No	Description	Half Load				
1	Fuel (Low Sulphur Diesel)	5500 ltrs				
2	Lubrication Oil	600 ltrs				
3	Fresh Water	3000 ltrs				
4	Crew	32				

Table 2. Loading Condition

2.7 Ships Particulars

Length overall	-	42m
Length between perpendiculars	-	39.04m
Breadth, moulded (max)	-	5.3m
Depth to main deck at mid ship	-	2.1m
Draught Fwd	-	1.4m
Aft	-	1.6m
Displacement at full load	-	146 Ton
Trial displacement (half load)	-	1700 Ton
Max. Speed at 100% engine	-	23 kn (knots)
Class	-	Fast Gun Boat

2.7.1 Main Engine Particulars

Number of Engines	-	04
Fwd Engine Power Output	-	895 kW
Aft Engine Power Output	-	840 kW



Image 1: Naval Vessel subjected to inspection

3. Conduct of Sea Trials and Salient Results

The trial team mainly focused on recording data at two fixed engine RPMs and analysing the spectrums resulted from earmarked machinery and hull locations. The salient defect patterns observed from the spectrums (0-200 Hz) are as follows,



Figure 1.1 Aft Port M/E Free end vertical at 1740 RPM - Angular Misalignment

Observation: High axial vibration amplitude. Pattern of typically high 1 X and 2 X with lowering 3 X, 4 X visible at engine RPM (29 Hz).



Figure 1.2 Aft Port M/E Free end axial at 1740 RPM-Structural Looseness

Observation: Phase unstable with many harmonics. Clearly visible $\frac{1}{2}$ X with 1 $\frac{1}{2}$ X and 2 X pattern. Many harmonics after 3 X.



Figure 1.3 Aft Stbd M/E Free end vertical at 1740 RPM-Offset Misalignment

Observation: Harmonics pattern persists at 1 X, 2 X, 3 X with comparatively higher 2 X. 1 $\frac{1}{2}$ X and 2 $\frac{1}{2}$ X also visible.



Figure 1.4 Aft Port Gear Box Drive end vertical at 1200 ERPM-Structural Looseness

Observation: Phase unstable with many harmonics. Clearly visible ¹/₂ X with 1 ¹/₂ X and 2 X pattern. Many harmonics after 3 X.



Figure 1.5 Fwd Port Gear Box Free end axial at 800 ERPM- Angular Misalignment

Observation: High axial vibration amplitude. Pattern of typically high 1 X and 2 X with lowering 3 X, 4 X visible at Gear Box rotational RPM



Figure 1.6 Port Self Align Bearing vertical at 800 ERPM- Offset Misalignment

Observation: Harmonics pattern persists at 1 X, 2 X, 3 X with comparatively higher 2 X. 1 $\frac{1}{2}$ X and 2 $\frac{1}{2}$ X also visible.

4. Findings of Results

During spectrum analysis followings were observed;

4.1 Main Engines

- a. Angular misalignment inAft Port M/E free end and drive end at 1740 rpm and Aft Stbd M/E drive end at 1740 rpm
- b. Structural looseness in Aft Port M/E free end axial at 1740 rpm
- c. Offset misalignment in Aft Stbd M/E at 1740 rpm

4.2 Gear boxes

During spectrum analysis followings were observed;

- a. Structural looseness in Aft Port G/B drive end vertical at 1200 rpm
- b. Offset misalignment in Aft Port G/B drive end (at 1200 rpm) and free end (at 1740 rpm) respectively
- c. Offset misalignment in Aft Stbd G/B free end axial at 1740 rpm
- d. Angular misalignment in Fwd Port G/B free end axial at 800 & 900 both rpm

4.3 Hull/ Miscellaneous

During spectrum analysis followings were observed;

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- a. Offset misalignment in Port Self Align Bearing at 800 rpm & 900 rpm
 - b. Offset misalignment in Stbd Self Align Bearing horizontal in 900 rpm
 - c. Structural looseness in Port inner gland box at 1740 rpm

Considering the above observations, it was recommended by the trial team to undertake followings for further defect analysis/ rectification.

- a. Re-check engine to gear box alignment of both Aft Main engines.
- b. Inspect for any deformation of mounting shoes of both Aft main engines and related components.
- c. Check the engine mounting and alignment of Fwd Port Main engine
- d. Ensure proper alignment of all four shafting

Further, it was evident from the vibration velocities of Port Inner propeller shafts for an excessive shipboard vibration. Hence, it was highly recommended to conduct a specific and proper survey on Port inner propeller shaft and associated components (propeller, rudder, self align bearing, struts and adjacent shell plates near stern tubes) during docking period. Considering past records, it was highlighted that few critical defects had occurred in Port inner shafting system and same observed during vibration spectrum analysis where, the vibration velocity readings in port inner gland box at 1740 rpm shows a structural looseness pattern.

5. Conclusion

The findings had been a scope of guidance for the repair staff to identify the docking repairs / refitting requirement by pin pointing the affected region. Further, the levels of vibrations of the vessel structure and machinery showed a clear cross over beyond alarm thresholds, where attention is critical. The most concerned vibration frequency region was 1- 200 Hz in order to identify hull and machinery spectrum variants. However, the conditions showed the vessel could be deployed few more years after attending minor rectifications during the immediate dry dock period. The vibration spectrum analysis on ships hull and machinery is a clear tool of Condition Based Maintenance (CBM) which is economical and beneficial towards project implementation and planning.

6. Acknowledgement

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Misconceptions about Atomic Models Amongst the Chemistry Students

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Abstract

Bohr's model is a semi-classical model which involves both classical and quantum principles. Although more sophisticated Schrödinger model has been presented to students, the residual picture in their minds persists to consider Bohr's model to be the closest to the physical reality. We included few questions about Bohr's model in tests to assess the students' understandings of realistic atomic models in generalchemistry courses offered for freshmen in two universities in the Middle-East (namely, Yarmouk University at Irbid, Jordan, and the United Arab Emirates University at Al-Ain, UAE, from both a statistical sample of 687 students was collected). The results reveal the existence of huge misconceptions amongst a large portion of the students' sample (i.e., \geq 85%). Alternative solutions are discussed and suggested to draw a strategy to better dissimilate the knowledge in order to overcome the existing learning difficulties.

Keywords: Critical thinking, Higher education, College students, Motivation pedagogy **PACS:** 01.40.Fk, 01.40.G-, 01.40.gb, 01.50.ht (*) **Corresponding author:** <u>ntit@uaeu.ac.ae</u>

1. Introduction

Atoms are the building blocks of matter and the understanding of their structures and properties is very fundamental for everything in life ranging from building blocks of nature to advanced nanotechnology. Historically, the discovery of atom and its structure passed through efforts of generations of talented scientists, starting from the Russian chemist Dmitri Mendeleev's discovery of the periodic table of elements in 1869 [1]. Yet, the breakthrough in discovering the structure of an atom occurred after the appearance of modern physics, in 1913, by a Danish physicist Niels Bohr together with Ernest Rutherford who depicted the atom and gave a model for the simplest atom of hydrogen [2-3]. Such a discovery has insighted all mankind and Bohr deserved, indeed, a Nobel prize in physics in year 1922.

Thereafter, three historical models of the hydrogen atom were developed, as been originally proposed by Niels Bohr [2], Louis de Broglie [4] and Erwin Schrödinger [5]. In the Bohr's model, electrons are point particles that move around the nucleus in circular orbits at fixed radii. In the de Broglie's model, electrons

are standing waves on rings with the same radii as in the Bohr's model. In the Schrödinger's model, electrons are clouds of probability whose density is given by the solutions to the three-dimensional Schrödinger's equation for the Coulomb potential that the electron feels from the nucleus. In all these preceding three models the knowledge of quantum mechanics is essential. Here occurs a great debate. Basically, some educators favor the postponement of teaching Bohr's model until the college level as they see that the quantum mechanics would not be appropriate at secondary level. The work of Fischler and Lichtfeld [6] has been cited in the physics education research (PER) community and beyond as evidence that it is preferable to avoid teaching Bohr's model entirely [7-9] and their claims have been incorporated into curriculum design [7]. Another group of educators [10-11] stood against such claims and saw that Fischler and Lichtfeld did not provide convincing evidence that teaching Bohr's model would prevent students from learning the Schrödinger's model. In particular, Petri and Niedderer [11] viewed a Bohr-like model as a necessary step in the learning pathway of a student and should rather be an important historical step in understanding atoms.

According to the US-National Research Council (US-NRC)'s report [12], science is defined to be "both a body of knowledge and an evidence-based, model building enterprise that continually extends, refines, and revises knowledge". In the perspectives of atomic models, the US-National Science Education Standards state that "each atom has a positively charged nucleus surrounded by negatively charged electrons"; but do not describe the properties of those electrons [13]. Thus, it seems that both national and district standards are silent on the question of which model(s) should be used to describe atoms for secondary-level (i.e., high-school) students.

In our view, the reports by Fischeler-Lichtfeld and US-NRC do not provide convincing evidence to avoid teaching Bohr's model in high-school, as they claim that that prevents students from learning Schrödinger's model. We stand with the fact that students need to study both introduction to modern physics and general chemistry since high school. They need to get familiar with the periodic table of elements, where shell-structure of electrons in an atom is ultimately needed. So, in the present investigation, we have included two conceptual multiple-choice questions about Bohr's model and more advanced atomic models and given them in a test to undergraduate students taking general chemistry course after the topic of atomic structure been covered. The same questions were proposed in tests for students in two different universities (namely, Yarmouk University at Irbid, Jordan, and UAE University at Al-Ain, UAE). The results reveal fascinating facts about the interests of students and their ability of grasping the existing atomic models of an atom. In next section, the results will be discussed.

2. Results and discussion

In both concerned universities, the general-chemistry-1 course [14] consists basically of the following topics: Matter and measurement; Basic concepts of chemical bonding and molecular structures; Chemical stoichiometry; Acids-bases and oxidation-reduction reactions; the atomic structure; and other related topics. In the chapter of atomic structure, several subjects are discussed in a sequence; namely as: the

electromagnetic radiation, the photoelectric effect, the duality aspects of light, the atomic spectrum of Hydrogen atom, Bohr's model, the quantum numbers, the periodic table of elements, respectively. Actually, these topics overlap with those taught in a Modern-Physics course [15] to Physics students. The subject of Bohr's model appears as essential amongst all these topics and to warrant its concept to be grasped by students is a very important matter. This model, of course, should consist a basic stone to further more sophisticated models fully based on quantum mechanics, such as Schrödinger's model. Usually tests like midterm and final exams are composed of two parts: (i) Multiple-choice questions (MCQs); and (ii) Solving problems. Here in this investigation, we will discuss the results of two MCQs proposed about Bohr's model to assess students about which model should be more realistic. The number of students participated in the test is 389 from Yarmouk University (YU) and 298 from UAE University (UAEU), which makes a total of 687 students. In MCQ # 1, students were tested whether they can recognize the

Table-1: Statistics of students answering MCQ#1 in two universities

	(a)	(b)	(c)	(d)	Total
# in YU	49	173	96	71	389
# in UAEU	36	172	60	30	298
Total	85	345	156	101	687



Figure-1: Statistics of students' answering question #1, which is about Bohr model in: (a) YU and UAEU Universities; and (b) Total. Note that the correct answer is (d).

name of the model or not. Namely, MCQ # 1 focuses on which model to use to best describe atom: (a) Thomson model; (b) Bohr model; (c) Rutherford model; or (d) None of those. Table-1 shows the results in number, while Figure 1 displays them in chart and pie diagrams. Figure 1a shows that the two universities (Yarmouk and UAEU universities) have about the same trends of results. While Figure 1b shows the total number of students choosing various answers. It is amazing to discover that only 15% of the total number got the correct answer (d), and among the 85% who got the wrong answers, 50% have chosen answer (b), which is wrong of course. More specifically, in UAEU, 10% got the correct answer (d), and among the

90% who got the wrong answers, 58% have chosen the wrong answer (b). Whereas, in YU, 18% got the correct answer (d), and among 82% who got the wrong answers, 44% have chosen the wrong answer (b). Answer (b) seems like a strange attractor to students. The trends between the two universities are similar and worth a serious investigation to analyze and to seek the reasons behind these shortcomings.

	(a)	(b)	(c)	Total
# in YU	31	302	56	389
# in UAEU	21	244	33	298
Total	52	546	89	687

Table-2: Statistics of students answering MCQ#2 in two universities





Figure-2: Statistics of students' answering question #2, which is about Bohr model in:(a) YU and UAEU Universities; and (b) Total. Note that the correct answer is (c)

Question # 2 deals with the behavior of electrons in an atom. Students were given 3 choices: (a) Electrons in atom to be immersed in a soup of positive charge; or (b) Electrons to act as particles moving around the nucleus in circular orbits at fixed radii; or (c) Electrons not to be confined to orbits but exist everywhere with a certain probability distribution. Table-2 shows the statistics of number of students answering various question in both YU and UAEU universities. The question is very conceptual and relies on visualization and students might have seen similar picture in logos such as the one of "International Atomic Energy Agency" (IAEA). Here as well, it is amazing that overall only 13% got the correct answer (c), and among the 87% who got the wrong answers, 75% have chosen the wrong answers, 82% have chosen the wrong answer (b). In YU, only 14% got the correct answer (c), and among the 86% who got wrong answers, 78% have chosen the wrong answer (b). So, the wrong answer (b) acts as false attractor to students in both universities. This reveals that students think that Bohr's model is the one closest to the reality of behavior of electrons in an atom. It is worth mentioning that the

study was conducted on several sections (taught by different instructors) at each university. The purpose of this study was to investigate the students comprehension of the ultimate atomic model and not to compare

universities in order to display the very similar trends in both institutions. This indicates that the ideas that the students possess about the Bohr's model is not connected with a particular institute or instructor. It is important to investigate the possible factors that contribute to this alarming misachievment of students in a basic concept of modern physics. We believe that the method of teaching practiced at the two different universities may play a major role. To our knowledge the conventional lecture practice where students act as passive receptors and where the instructor act as an authority of knowledge is practiced at both universities and in many other parts of the middle east region. Students are not the center of the learning process but rather it is the instructor who controls the stage. This conventional practice disconnects the students from their learning process and attributes to the shortcoming of their acheivment. This conclusion has been pointed out by many researchers who have investigated ineffectivness of the conventional method of teaching [16-17]. Another possible factor could be related to students' attitudes toward learning, their expectations, and the lack of motivation. Such factors plays a major role in the students's detachment of their learning process, as investigated by few researches [18]. Lack of critical thinking among students could also play an important role. According to some researchers, low achievement of students could be related to teachers' beliefs and attitudes in shaping education and students experience [19]. In our case of study, the above mentioned factors should be investigated further to identify the ones that play major role in the students' misconceptions about the Bohr model and the atomic structure in general.

3. Conclusion

The Bohr's model of hydrogen atom is one of the fundamental topics that should be considered a prerequisite concept necessary for the understanding of atomic structure using quantum mechanics. A large sample of general-chemistry students were exposed to two basic questions about Bohr's model at two different universities (YU and UAEU). For the first question, we notice that more than 85% of the students got wrong answers while a large percentage of students agree to select the same wrong answer, indicating the Bohr's model is the correct model of describing the atom. Similarly, for the second question, when students were asked about the behavior of electrons in an atom, only 13% got the correct answer, while a large percentage of students agree to select the results of study display very similar trends in both institutions where the course is delivered for multi-sections and by different instructors. This indicates that the concepts the students possess about the Bohr's model are not connected with a particular institute or instructor.

The low performance of students in the topic of Bohr's model could be traced to several factors. For example, the conventional method of teaching practiced at the two different universities may play a major role. In the conventional method of teaching, students act as passive receptors and instructor act as an authority of knowledge. Students are not the center of the learning process but rather it is the instructor who controls the stage. This practice disconnects the students from their learning process and attributes to the shortcoming of their acheivement. Another possible factor could be related to students' attitudes toward

learning, their expectations, and the lack of motivation. These factors play a major role in the students's detachment of their learning process. Lack of critical thinking among students could also play an important role. In addition, low achievement of students could be related to teachers' beliefs and attitudes in shaping education and students experience.

We suggest few possible practices to elevate students' misconceptions. Instructors are encouraged to deviate from the traditional method of teaching and focus on students as major player in the learning process. Students should be involved in the content discussion and problem-solving practice in class. Students should be encouraged to actively participate in the course progress and encouraged to be independent thinkers. Finally, we believe it is essential for students to appreciate and be aware of the importance of the topic in modern science.

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The authors would like to thank all instructors whose classes were included in the study.

Appendix: The Multiple-Choice Questions

Chose the correct answer for the following questions:

Question #1: An accurate understanding of atoms is provided by

- (a) Thomson Model
- (b) Bohr Model
- (c) Rutherford Model
- (d) None of the above

Note: The correct answer is (d).

Question #2: The most accurate image that reflects the current understanding of electrons in atoms is:

www.ijier.net



soup of positive charge



(b) Electrons are point particles that move around the nucleus in circular orbits at fixed radii.



(c) electrons are not confined to orbits, but exist everywhere according to a probability distribution.

Figure-3: Various atomic models. The images were obtained from several websites. Note: The correct answer is (c).

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The Brazilian Ceremony in Honor of Body Donors: An opportunity to express gratitude and reflect on medical education

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ABSTRACT

Introduction: Memorial ceremonies are a way for institutions to show their gratitude for the gesture made by body donors and are an opportunity for students to reflect on the ethical paradigm shift. Therefore, this study aims to describe the memorial ceremony at the Federal University of Health Sciences of Porto Alegre and assess the perception of both students and the donors' relatives regarding the event.

Material and methods: In 2016, a questionnaire was applied to donors' relatives with questions regarding structure of the ceremony, ethical training of the students and importance of body donation. Another questionnaire was applied to the first-year students of the medical school, with questions about understanding the use of bodies, and their thoughts on death and relevant ethical issues.

Results: Fifty questionnaires were answered by family members and 98% agreed that the ceremony was an opportunity to feel closer to the donors and 100% said that the ceremony is important in the ethical training of students. Among students, 68 questionnaires were answered, and all affirmed that the event had a positive impact on the perception of physician-patient relationship and personal growth, and 86.7% reported enhanced empathy.

Conclusion: The memorial ceremony seems to encourage students to reflect on ethical issues, because at the same time that the donors' relatives perceive an attitude of care and respect on the part of the students, the students state a heightened sense of commitment and responsibility regarding their learning and professional formation, which depends on the gesture made by the donors.

Keywords: anatomy, empathy, medical education, body donation, memorial ceremony

Introduction

The dissection of human bodies is fundamental to the study of Human Anatomy, because it enables students not only to develop technical skills, but also to learn to work in a team, to be aware of anatomical variations, to understand death and to value human beings, especially when in their most vulnerable state [1-2].

Despite the development of synthetic models, which closely resemble the human body, and complex 3D anatomy programs, such features are no substitute for learning by dissecting a cadaver [3]. Universities that abandoned the use of human bodies for teaching have subsequently reintroduced their use, due to the

detriment caused to the students' learning [4]. Thus, new technologies for teaching anatomy should serve as a complement to the use of corpses, not to replace it [3,5].

Therefore, to maintain the use of cadavers for teaching, voluntary body donation has been adopted by many medical schools in different countries as the only means of obtaining the necessary bodies, always in conformity with local legislation [5-10]. In some countries, however, the absence of well-established body-donation programs and cultural and religious obstacles means the use of unclaimed bodies remains the only viable option [11].

In Brazil, although most universities use unclaimed bodies from the Legal-Medical Departments, number is declining annually [12]. Added to this is the increase in the number of medical schools in the country which has occurred in recent years [13]. Moreover, much of the population is unaware of the possibility of donating one's own body in life. Faced with this situation and the need to obtain bodies to maintain an adequate quality of teaching, in 2008, the Human Anatomy Discipline of the Federal University of Health Sciences of Porto Alegre (UFCSPA) created the Body Donation Program for Teaching and Research in Anatomy (PDC) [14]. This program aims to raise the awareness of the population, through publicity campaigns, regarding the possibility of donating the body and how to do so. For this purpose, the PDC uses documents that ensure the seriousness and legality of the process of donating the body in life and after death.

Thus, in view of the good results obtained by the PDC [5], with the greater availability of materials over the years, other interconnected activities have been developed, which became the Extension Program in Anatomy. The Program is composed of several complementary projects: the Body Donation Program, the Dissection Workshop, the Museum of Anatomy and the Ecumenical Service in Homage to Body Donors.

The Dissection Workshop is a 40-hour extension course, which is offered annually to undergraduate students who have already completed the anatomy discipline. Students attending this discipline can expand their knowledge in anatomy in addition to developing surgical skills. The anatomical pieces produced during the Dissection Workshop are used in the anatomy practical classes and some of those are selected to be exhibited in the Museum of Anatomy. The latter is a temporary exhibition, of variable duration (10 to 20 days), which has taken place annually since 2008, through which the community can see how the bodies donated to anatomy teaching at UFCSPA are used. In addition, at the end of each year, students and teachers have the opportunity to thank the donors' families for their altruistic gesture in making the donation, through the Ceremony in Homage of Body Donors. This ceremony is the cornerstone of all the work, as it serves to endorse the program for teachers, students, and the donors' families.

Thus, the purpose of this study is to describe the ceremony held at the UFCSPA to honor donors as well as to discuss the ethical paradigm shift regarding the use of voluntarily donated bodies. Besides, was analyzed the opinion of the donors' family about the Ceremony and the students' perception of it, evaluating their involvement in the ceremonies in homage of body donors.

Methods

The ceremony

Since 2010, at the end of each year, UFCSPA's undergraduate students (Biomedicine, Nursing, Medicine, among others), together with fellows of the Extension Program in Anatomy and professors of the discipline of Human Anatomy, have been involved in organizing and conducting a thank-you ceremony for body donors. The ceremony marks the end of the PDC's annual activities and is keenly awaited by the first year students, who conclude the discipline of anatomy and see the event as an opportunity to pay their respects.

The students participate in all stages of the ceremony, from its planning and organization, to coordination and conduction, being responsible for decorating the space, inviting and welcoming the guests (the donor's families), selecting and presenting the songs and writing the speeches. They are also responsible for inviting a religious representative to offer words of comfort, based on consensus among the students. The ceremony has been ecumenical since its first edition in 2010, and representatives of various faiths including Buddhism, Catholicism, Protestantism (Lutherans), Spiritism, the Seicho-No-Ie philosophy and theologians have been invited.

The ceremony begins with a song being sung and played by the students to welcome visitors which is followed by brief speeches of thanks from members of the Rectory, the PDC coordinating committee and representatives of the students involved in organizing and conducting the event. It is an opportunity for the students to freely express their feelings and their thoughts regarding voluntary body donation and its fundamental role in their ethical, humanistic and professional training, as well as reflecting on the finitude of life, death and their meaning.

The ceremony continues with the 'Candle Ceremony' in which each student carries a candle representing each of the bodies received by the PDC in the current year and each year of program's existence. At the same time, the students prepare a video with photos of the donors, provided by their families, while reading a list with the names of all the donors of the bodies received since the beginning of the Program. At the end, the families are presented with flowers delivered by the students, along with a message of thanks for the altruistic gesture of the donation.

Until 2015, the ceremony was held in UFCSPA's Ecumenical Chapel. In 2016, however, it took place at the University Theater, which made it possible to better accommodate the guests because of its greater size, and yet it still reached maximum capacity. About 240 people, among them students, teachers, staff and families, were present.

In the closing moments, when the students are closer to the donor relatives, thanks and farewells are expressed among smiles and tears. Students thank family members for attending the ceremony and having allowed and supported the donation, which is reflected in the enhanced formation of the students involved in organizing and conducting the event, while in turn, the family members have the opportunity to say goodbye to their loved ones and to find comfort in the ceremony in which they can perceive the students' care and gratitude towards both the donors and the relatives' agreement to respect the donor's wishes. Figures 1 and 2 demonstrated some moments the 2016 edition of the event.



Figure 1. Ceremony in honor of the Body Donors Photos - 2016. (a) 'Candle Ceremony': students carrying candles representing each of the bodies received by the BDP in the year. (b) First-year students from the medical school presenting a rose to the donors' relatives of them. (c) Invitation sent to donors' relatives by PDC.



Figure 2. Ceremony in honor of the Body Donors -2016, including students who participated in the organization of the ceremony.

Data and statistical analysis

The numbers of family members and students that have participated in the ceremonies in the period from 2010 to 2016 were evaluated. In addition, the data obtained from a questionnaire applied to first year medical students involved in the organization and conduction of the ceremony in the year of 2016 were analyzed. The questionnaire consisted of 30 statements with which the respondents could express the degree to which they agreed or disagreed using a Likert scale [15] (Sullivan and Artino, 2013). The areas covered by the questionnaire included the importance of practicing dissection in developing academic knowledge, in developing teamwork, regarding the use of bodies and their thoughts on death. Other questions were related to their knowledge of the processes by which bodies are obtained for the study of Anatomy, about their knowledge of the Program before joining the University and if, following completion of the discipline, there had been any change in their attitude towards donors, as well as the extent to which the Program influenced their ethical and professional training. Further questions focused on the importance of the Ecumenical service: whether participation in the ceremony increased their care for donors, whether it impacted on academic experience, on personal growth and whether the student felt any increase in the level of empathy. In addition, they were asked whether the ceremony influenced their ability to perceive the bodies as individuals. Finally, it asked whether the student would consider donating his/her own body or that of a relative to the teaching of Anatomy.

Data obtained from a questionnaire applied to family members present at the event were also analyzed. The form consisted of 10 questions regarding the organization of the ceremony, such as its duration, content infrastructure and reception at the venue, as well as questions about the impact of the ceremony, the ethics of the students and the importance of this expression of gratitude.

The study was approved by the Ethics in Research Committee of UFCSPA (no.721/08). The data were collected in via questionnaires using Google Forms and later analyzed using the IBM SPSS v.21 program (IBM Corp., Chicago, Illinois).

Results

From 2010 to 2015, an average of 75 visitors and 60 students participated in each edition. In 2016, with the larger venue, approximately 250 people participated, among visitors and students. These figures indicate a total of 1050 participants, including the donors' relatives, outside visitors, students, teachers, administrative staff and members of the organizing committee.

From a total of 107 students in the 1st year of the medical course, 68 students involved with the organization or conduction of the ceremony answered the questionnaire. It was observed that 91.1% (62) stated that participating in the Ecumenical service increased their feelings of responsibility regarding the corpses used for teaching. Everyone agreed that the Ecumenical service had a positive impact on the academic experience and personal growth. In addition, 73.5% reported a positive impact on the doctor-patient relationship and 86.7% reported a heightened sense of empathy. Of the respondents, 67.6% stated that the ceremony facilitated reflection on death, 55.8% reported that their participation made them think about the possibility of donating their own body for teaching and 83.8% reported that after participating they would agree to donate the body of a family member.

Fifty questionnaires were answered by the relatives of donors and outside visitors attending the 2016 edition. Of these, 21 had participated in previous editions. Of the respondents, 98% (48) agreed that the Ecumenical service was an opportunity to feel closer to the donor and 100% stated that the ceremony is important in the ethical formation of the students and also as a gesture of gratitude to the donors. Of the total, 90% (45) of the respondents said they felt more confident about donating bodies after observing the students' attitude towards donors during the ceremony. In addition, 34% of the respondents said that having attended the ceremony had influenced other relatives to also donate their bodies.

Discussion

Institutions in countries around the world hold ceremonies to express gratitude to body donors and their family members [16-22]. This represents a paradigm shift in the context of medical training by emphasizing the importance of "humanity and compassion" [22]. In this sense, it is important to point out the fact that most ceremonies are conducted by the students [22]. Thus, many donation programs have treated the donated bodies as 'first patients' or as 'teachers' because of their importance for academic growth [2, 21-22].

Around the world, there are slightly different approaches regarding such ceremonies. For example, the annual ceremony held by the Mayo Clinic School of Medicine, entitled 'The Convocation of Thanks', aims to provide students, teachers, professionals and families with an opportunity to comprehend the value of gesture of the donation [16]. In Thailand, two ceremonies are held, one at the beginning of the school

year, involving students, academic staff, family members and Buddhist monks, in which the names of the donors are announced and they are awarded the title of 'Great Teacher', and another at the end of the year, in which students carry their 'teachers' to the cremation site [2, 17]. There are other examples from countries and regions such as South Korea [23], New Zealand [6], Africa [24], Spain [25], China [26] and the Netherlands [20], all of which include forms of appreciation, ranging from the construction of chapels to memorials, all of them focusing on the fact that there is no specific place for the funeral of the loved ones [11]. In addition, it is apparent that such ceremonies have a positive effect on the number of donations [11].

In Brazil, most of the population believes that medical schools use unclaimed corpses for teaching and research purposes and, furthermore, that this is not be a problem since the bodies are abandoned. However, the PDC is working to change this paradigm. Body donation programs are slowly expanding in order to inform the population of the possibility of voluntary body donation in life [5, 14]. In this context, students play an important role, acting as agents, disseminating information and conducting ceremonies in honor of donors. The ceremony as well as the related activities lead students to understand and reflect on the fact that volunteer donors provide their bodies altruistically, believing that by doing so, they will contribute to the development of trained professionals and that, because of this attitude, students should be committed to learning [5]. In addition, ceremonies allow students to acknowledge and express gratitude to the donors and their families for the gesture, which stimulates a greater sense of professional responsibility [27]. It also provides students with an understanding of life and death by encouraging them to reflect on their own mortality [28].

The findings of the surveys conducted in this study suggest not only the importance of the ceremony for the donors' families, who forwent traditional funeral rituals in order to respect the desire of their loved one to be a donor, but also in relation to the perception of the role of the donor in enhancing ethical attitudes among academics, which enables the development of more humane and altruistic interactions in the physician-patient relations of those future professionals. In addition, the attitude demonstrated by the students and observed by family members during the ceremony offers greater confidence for donors' relatives regarding body donation.

Similarly, through the questionnaires answered by the students who organized and participated in the event, one can perceive the considerable value attributed to this ceremony, since everyone agreed that there was a positive impact on their academic experience and personal growth. Moreover, these results show there is greater care and respect for corpses used for teaching, together with a more intense reflection on death and an increase in the feeling of empathy towards others, which may lead to the establishment of more positive doctor-patient relations. Thus, the results suggest an important degree of recognition of the Ecumenical service and the donation of bodies on the part of the students, since the majority stated their participation provided an opportunity to reflect on the possibility of donating their own body and that they would agree to donate the body of a relative for teaching purposes.

In addition, the opportunity to reflect that the ceremony provides the students, predisposes an important paradigm shift, since unlike the case of unclaimed bodies, the donor offers his/her body voluntarily in an act of altruism, believing that his gesture will contribute to training better medical

professionals [5]. Thus, the comprehension of this fact helps the students fully realize the dimension of the commitment and responsibility required for their own learning [27].

Although this ceremony is intended to express gratitude to the donors and their families, the students have always included a religious aspect. Possibly it happen because 92% of the population claims to have some religious belief [29], although Brazil is a secular country. In some oriental cultures, the ceremonies are essentially religious in nature [17, 30]. However, in a study of the solemnities conducted in anatomy programs in the United States [22], the authors reported the use of religious verses, texts or sentences on only 6% of occasions, suggesting that religious discourses are avoided due to the heterogeneity of the population.

Another important aspect is donor confidentiality. In some programs, the identity of the donor is preserved [22]. Nevertheless, there is a tendency to reinforce the identity of donors as individual human beings rather than as anonymous corpses, in the hope of building the students' attitudes toward their future patients [17,22]. In 2013, we began naming the donors during the ceremony to make it more personal, which is intended to strengthen the welcome and gratitude expressed to the donors' families while providing an opportunity to remember and say goodbye to loved ones, as they have forgone traditional and family funeral rituals by respecting the donor's wish to donate the body. In addition, the large number of students present and the respect shown to the donors, conveyed by words and gestures during the ceremony, demonstrate the seriousness of the students and reassure the families regarding the care taken with each donor's body.

Thus, based on our data, the Memorial Ceremony seems to have encouraged greater reflection on ethical issues on the part of the students, because while the families perceive an attitude of care and respect expressed by the students, the students claim it heightens their commitment and responsibility towards their learning and professional training, which is dependent on the donor's actions.

Therefore, the Extension Program as a whole depends on the involvement of the students, both scholarship holders and project volunteers, working in its organization and conduction, as well as those attending the activities and courses. Hence, the students at the end of the first year of the medical course, when finishing the discipline, participate in the organization of the ceremony. While second, third, and fourth year students can participate in the dissection workshop, the Anatomy Museum, and the PDC, and apply for fellowships or participate in the projects as volunteers.

In short, the Ceremony currently functions as the link between all the activities within the Extension Program in Anatomy, providing as sense of accomplishment for these events. Thus, through the Dissection Workshop and the Museum of Anatomy, students are offered the opportunity to improve their technical and scientific abilities while simultaneously increasing their awareness of issues related to the need and importance of donating bodies in life, in order to continue such activities. It also encourages reflection on ethical issues, in an attempt to modify paradigms, starting in the first year of the course, through the Ceremony, raising awareness, and increasing responsibility and dedication to learning. And during the course, by assuming the commitment to transmit the knowledge received to the community in the form of education and art, through the Museum of Anatomy and, finally, with the improved training, ensure a differentiated quality of service to future patients.

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Simulator for Lean Manufacturing Applications: Quick Change Case

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Abstract

An educational case implementing a SMED (Single Minute Exchange of Dies) teaching method with results that measure the participating student's perception is reported. This method significantly reduces training time and increases knowledge retention as a result of an improvement aimed at shortening the learning cycle of industrial engineering students learning about lean manufacturing tools. This study was conducted with a hundred students who are the population of industrial engineering in a small college.

Keywords: Simulation, Lean Manufacturing, Experiential Learning

1. Introduction

This research paper addresses the impact of knowledge transmission through the practice of lean manufacturing techniques by means of physical simulation machines. The term 'machine simulation' is used as opposed to 'virtual simulation'.

McManus [1] state that simulation-based learning of complex, lean manufacturing concepts is an active learning mode. It pursues the following objectives: To increase understanding, to improve contextual and holistic understanding, to promote experience-based learning, and to increase student participation and enthusiasm[2],[3],[4]. Other benefits, such as teamwork are also considered.

This research aims to assess retention of knowledge transmitted through the experiencing of lean manufacturing techniques, e.g. quick-change tooling.

1.1 Description of the simulator

The simulator has a workbench, on top of which were placed metal profiles to carry out punching operations to produce designs requested by a customer [5]. This particular simulator produces car license plates. The dies that are appropriate for the manufacture of the design requested by the customer are placed on the workbench. Both tooling and dies are interchangeable, thus allowing adaptation to changes requested by the client.

Initially, students work with traditional elements used to fix the tooling, such as screws of various sizes – similar to those used in industry— with the support of wrenches to secure bolts, nuts and washers.

Subsequently, students learn appropriate technical procedures that reduce die tooling removal times, and improve placement rates for dies and tooling.

The experiment was conducted with students who had no previous knowledge of lean manufacturing techniques. Students interact with the simulator by following instructions in a guidebook, adhering to customer and production requirements, and comparing lean techniques to traditional mass production techniques. Due to the changes which take place customer demands, students will quantify results on a spreadsheet especially designed for this purpose. The spreadsheet results will be used as financial indicators. Without claiming that simply using SMED all production problems will be solved and timely delivery of products will be assured; an improvement of the conditions that allow manufacturing firms to gradually improve their processes is attempted. If industries perform tasks more quickly and accurately, a more competitive position will be achieved in this globalized world.

A first approach to a hypothesis states that the development of a simulator for lean manufacturing applications can mimic actual situations in industry. Once the simulator is conceived, designed, built, and made operational, it will improve teaching - learning techniques through actual experience. This experience will be measured by more specific approaches shown below.

1.1.1 Sample Selection.

The sample was determined from a population of 102 Industrial Engineering students at a small private university. The sample size was calculated using the methodology proposed by Triola [6] which resulted in a sample size of 81.

In order to conduct a quasi-experiment with two relatively equal groups where no work is done by random selection, the students were placed into two groups with intentionally balanced grade-point averages (GPA) and coursework advancement. These two groups were gender balanced. To ensure the balance between GPA, average credits approved, and gender composition between the two group's hypotheses, tests of these variables were conducted and a confidence level of 95% was obtained.

1.1.2 Quantitative Approach

The primary variable was defined as the score on a test of knowledge of SMED (Single Minute Exchange of Dies), which corresponds to questions 1 to 5 of the questionnaire items. We found that knowledge retention is increased by means of the physical simulator as compared to the traditional methods of teaching using Power Point slides.

- A five-question test was structured for the students. The questions were:
- 1 How do you classify SMED time?
- 2 What is the main characteristic of each type of SMED time?
- 3 If you want to increase production, which SMED time do you have to reduce?
- 4 What is the disadvantage of using nuts and bolts in SMED?
- 5 What else can you do to reduce tooling changeover time?

1.1.3 Qualitative Approach

Greater participation and involvement is achieved from students who receive training through simulation machines than by traditional instruction with slide presentation. The definition of the primary variable is the result of an analysis of the survey conducted at the end of the presentation-and-experimentation, or, experimentation-and-presentation of the SMED Quick Change Tooling technique.

Before the evaluation, slides were prepared and sound was recorded in order to ensure that the presentation time and informational content were the same for all samples.

All tooling, systems and support equipment were prepared for students so they would have everything needed to experience the active Quick Change.

During the evaluation, tooling was provided to the control group. A questionnaire was applied to both groups after either the Power Point slide presentation or the practical experience. The slide presentation time was controlled by timing each slide and a timer was used for the practical experience, so the time spent with each group was equal. See Figure 1.



Figure 1. Comparison between groups with different teaching - learning techniques.

After the evaluation, the data obtained from the test and the codification of the surveys was captured. The data as well as the results obtained were analyzed in a consistent and logical manner. The instrument reliability was reviewed. Conclusions were reached and recommendations were made.

1.1.4 Structure of the questionnaire

After the slide presentation, a knowledge test was applied to the traditional slide presentation group. After the test the traditional slide presentation group was briefly exposed to the other technique, i.e. experiential,

and then they were asked to fill out a survey.

On the other hand, the experiential group first carried out the hands-on technique and then were asked to answer the knowledge test, after which they were shown the Power Point slide presentation, and subsequently filled in the survey.

2. Results

It should be mentioned in this section that an important by-product of this paper is the design and manufacturing of the simulator, which allowed us to represent actual industry scenarios and particularly the Quick-Change Tooling technique.

2.1 Quantitative Methodology

The scoring used to grade this test was two (2) points for a correct answer and zero (0) points for an incorrect answer. One (1) point was assigned to each partially correct answer.

The test was analyzed in a comprehensive manner by comparing the total average achieved by the group who received traditional instruction against the group who received Experiential training, and through a test of the hypothesis comparing averages in the first case and variability in the second.

Then each of the answers from the group that received traditional instruction and the group that received experiential instruction was compared. That is, the score average of question one by the traditional group was compared to the score average of question one by the experiential group, and so on. Overall, hypothesis tests are developed by following four steps: The approach of the null and alternative hypotheses, test statistics, rejection region, and both statistical and practical conclusions.

The knowledge test and the overall comparison of each of the questions were carried out.

For the analysis of general knowledge, the following hypotheses are proposed:

H₀₁, the average scores obtained by the Traditional Slide Group (D), is equal to the average ratings of the Experiential or Hands-on Group (E), $\mu_E = \mu_D$

 H_{A1} , the average scores obtained by the Traditional Slide Group (D), is below the average grade of the Experiential Group (E) $\mu_D < \mu_E$

After the experiment, HO was rejected. There is sufficient evidence for a confidence level of 95% to assert that the average grades of Group D are lower than the average grades of Group E. See Tables 1 and 2.

		Grade
Total of Traditional alida group	Average	6.5111
Total of Traditional - side group	Standard Deviation	2.4460
	Average	8.8222
Total of Experiential group	Standard Deviation	1.7227

Table 1 Overall results of the knowledge test

	Question	1	2	3	4	5	Grade
Total for Traditional - slides group	Average	1.4444	1.2667	1.6889	1.5333	0.5778	6.5111
	Standard Deviation	0.8933	0.9145	0.7014	0.8146	0.8391	2.4460
Total for Experiential group	Average	1.8667	1.7778	1.8222	2.0000	1-3556	8.8222
	Standard Deviation	0.5045	0.6356	0.5347	0.0000	0.8300	1.7227

Table 2 Comparative results of each of the questions on the knowledge test

For the rating variability, the following hypotheses are proposed:

H₀₂; score variability obtained by the Traditional Slide Group (D), is equal to the rating variability of the Experiential or Hands-on Group (E), $\sigma^2_D = \sigma^2_E$

 H_{A2} ; score variability of the Traditional Slide Group (D) is higher than the average ratings of the Experiential Group (E), $\sigma^2_D > \sigma^2_E$

 H_0 is rejected at a 95% confidence level. There is sufficient evidence for a confidence level of 95% to assert that the rating variability of Group D is greater than the rating variability of Group E. See Table 3.

		Grade
Total for Traditional -	Average	6.5111
slides group	Standard deviation	2.4460
Total for Experiential	Average	8.8222
group	Standard deviation	1.7227

Table 3 General Results knowledge test - variance

2.1.1 Hypothesis analysis

Analyzing each of the hypothesis, we have:

Hypothesis 1

 H_{O3} , the average scores obtained for question 1, from the Traditional Slide Group (D), are equal to the average scores for question 1 of the Experiential Group (E), $\mu_E = \mu_D$

 H_{A3} ; Average ratings for question 1 in the Traditional Slide Group (D), are less than the average ratings for question 1 of the Experiential Group (E) D $\mu_D < \mu_E$

 H_0 is rejected at a 95% confidence level. There is sufficient evidence at a confidence level of 95% to assert that the average grade for question 1 from Group D is less than the average grade of question 1 from Group E.

Hypothesis 2

H₀₄; Average scores obtained for question 2, through the Traditional Slide Group (D), are equal to the average ratings for question 2 for the Experiential Group (E), $\mu_E = \mu_D$

 H_{A4} ; Average ratings for question 2 Traditional Slide Group (D) are lower than the average ratings for question 2 Experiential Group (E) $\mu_D < \mu_E$

 H_0 is rejected at a 95% confidence level. There is sufficient evidence at a confidence level of 95% to assert that the average grade for question 2 from Group D is below the average grade for question 2 in Group E.

Hypothesis 3

H₀₅; Average scores obtained for question 3, by Traditional Slide Group (D), are equal to the average scores for question 3 of the Experiential Group (E), $\mu_E = \mu_D$

 H_{A5} ; Average scores for question 3 Traditional Slide Group (D) are lower than the average ratings for Question 3 Experiential Group (E) $\mu_D < \mu_E$

 H_0 is not rejected at a 95% confidence level. There is sufficient evidence at a confidence level of 95 % to assert that the average scores for question 3 Group D are not lower than average scores for question 3 in Group E.

Hypothesis 4

H₀₆; Average scores obtained for question 4, in the Traditional Slide Group (D), are equal to the average of scores for question 4 in the Experiential Group (E), $\mu_E = \mu_D$

 H_{A6} ; Average scores for question 4 in the Traditional Slide Group (D), are below the average of scores for question 4 in the Experiential Group (E) $\mu_D < \mu_E$

 H_0 is rejected at a 95% confidence level. There is sufficient evidence with a confidence level of 95% to assert that the average grade for question 4 from Group D is lower than the average grade for question 4 in Group E.

Hypothesis 5

H₀₇; Average scores obtained for question 5, in the Traditional Slide Group (D), are equal to the average scores for question 5 of the Experiential Group (E), $\mu_E = \mu_D$

 H_{A7} , The average grade for question 5 of the Traditional Slide Group (D) is less than average scores for question 5 in the Experiential Group (E) $\mu_D < \mu_E$

 H_0 is rejected at a 95% confidence level. There is sufficient evidence with a confidence level of 95% to assert that the average scores for question 5 in Group D are lower than the average scores for Question 5 in Group E.

2.1.2 Measuring attitudes

Referring to the survey, about preferences between the Traditional Slide and Experiential groups, the following questions were asked:

1. Is the teaching - learning process through presentation of slides (or hands-on experimentation),

attractive to you?

2. Does the presentation (or hands-on experimentation) allow you to learn the concepts shown?

3. Does the slide presentation (or hands-on experimentation), allow you to understand its content?

4. Over time, will you remember what you have learned through slide presentations (or through hands-on experimentation)?

5. It is easy to maintain my attention with slide presentations (or hands-on experimentation), in the teaching – learning process?

6. Does the slide presentations (or hands-on experimentation), make it easier to think for yourself?

7. Can you more easily implement what you learned through slide presentations (or through handson experimentation)?

8. Can you more easily recognize the importance of rapid change, explained through presentations (or through hands-on experimentation)?

2.2 Qualitative methodology

Quantitative methodology was used. An instrument for students with a Likert scale with four response options (I Totally Agree, I Agree, I Disagree and I Totally Disagree) was used. The choices "I Totally Disagree" (TD), "I Disagree" (D), "I Agree" (A) and "I Totally Agree " (TA) were transformed into a numerical code (-2, -1, +1 and +2) that would:

a) Recognize the bipolarity of the scale - a TA TD - (4 options), and

b) Record the maximum net data for each statement and its valuation in the set.

The resulting value varies for each statement, ranging from 100% for the highest positive attitude to -100% for the lowest negative attitude.

This process of "mutual assessment" of positive and negative values obtains the net trend among respondents.

The survey was reviewed by Cronbach's alpha test. It was concluded that the measurement instrument is reliable. Variance of the items was reviewed, as well as the Correlation Matrix. The result was 0.9065.

The attitude may be interpreted according to the ranges in the following tables. See Table 4:

LEVEL	INTERVAL
Very good	25% to 100%
Good	0% to less than 25%
Bad	-50% to less than 0%
Very bad	-100% to less than -50%

Table 4 Students' attitudes

For the Slide Group See Table 5:

TA	0.0222	0.0000	0.0889	0.0667	0.0444	0.0000	0.0000	0.0667
Α	0.4000	0.5333	0.7111	0.2000	0.2000	0.3556	0.4444	0.5556
D	0.5333	0.3778	0.1556	0.6000	0.6444	0.5556	0.4667	0.3333
TD	0.0444	0.0889	0.0444	0.1333	0.1111	0.0889	0.0889	0.0444
				Grou	up D			
	A1	A2	A3	A4	A5	A6	A7	A8
	-9%	-1%	32%	-27%	-29%	-19%	-10%	13%

Table 5 Table of results about the group's attitude to the slides

For the Experimentation Group. See Table 6:

Table 6 Table of results about the group's attitude toward the slides

TA	0.8667	0.6000	0.8667	0.4667	0.4889	0.5333	0.5111	0.6222
A	0.1111	0.4000	0.1333	0.5333	0.4667	0.4222	0.4889	0.3778
D	0.0222	0.0000	0.0000	0.0000	0.0444	0.0444	0.0000	0.0000
TD	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
				Grou	ıр Е			
	A1	A2	A3	A4	A5	A6	A7	A8
	91%	80%	93%	73%	70%	72%	76%	81%

3. Analysis and discussion

Often when building a prototype, it is easy to lose sight of the goal by working on modifications and improvements to the original proposals, either in materials, forming or cutting processes, in assembly, the fastening system, support and other issues. To keep this procedure from becoming an endless spiral of improvements in manufacturing, which can cause paralysis by analysis, it is common sense to restrict modifications in order to achieve the original goal and meet the original requirements. Without disparaging the improvements made to the simulator, you can keep track of any changes that may be reflected in improved versions.

More than just representing a real scenario, we actually wanted a real live scenario. A student who actually stamps, cuts or bends a material acquires the experience of the resistance and memory of the material by touching, holding, handling and feeling movement restrictions in real industrial environments. Working with pneumatic or mechanical forces when striving to obtain a final product or process, is something that sticks in people's minds. We got as close as possible to real life scenarios.

4. Conclusion.

Firstly, the importance of the technique was based on clearly separating internal and external time, seeking to minimize internal time which does not add value to the process and to maximize external income which

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adds value at every step. Grasping these times was essential to ensure that the trainee paid attention to them and implemented whatever was necessary to make the process ever more productive.

At present, the use of programs such as computer-aided design, computer-aided manufacturing and computer-aided engineering (CAD, CAM and CAE) is very common. Working with 3D models, where you can select the material to be made or analyze its capabilities in terms of tensile and compressive force, shear, and bending, among others, allows us to verify the capabilities proposed in the initial design and modify them to reach optimum size sections according to defined constraints. We can make changes easily, basically investing only our time.

New dimensions, new materials and new finishes are shown on the screens of computers. We can even add moving parts and apply forces or pressures indicating the weak parts and parts that exceed the forces that arise.

Building a machine with previously defined dimensions (90 x 50 x 40 centimeters and 20 kilograms), allowed us to set boundaries to avoid creating a heavy, bulky, machine that was difficult to transport or move. Therefore, a machine capable of representing actual processes in industry was built. Processes implemented were stamping, cutting, bending, and punching, by means of a piston supplied with air under pressure and safety systems, to protect the integrity of the operator's hands.

This machine has an air pressure regulator which allows it to vary from 0 to 120 pounds per square inch of pressure (0 to 8.4 kg/cm2 or 0 to 8.3 bar), along with a pressure gauge. It has an adapter to quickly connect and disconnect the compressor, allowing for mobility without the use of additional tools such as wrenches. With materials such as aluminum or tin the machine can stamp, bend and cut, crimp, punch or shear. All of the above depending on the tooling used, which when exchanged, fulfill the technical objective of study which is the purpose of this paper.

The quick change tooling, through the Experiential technique was implemented to be used by Industrial Engineering students. They were able to experience the use of props that helped change tooling, without taking them a long time. Angles, flat surfaces, slots, open media and open washers were used to bring down the time it takes operators to change the tooling. No matter your gender, once trained, you can work on this technique, practicing this hands-on technique for the exchange of dies or tooling.

The students had previously had the experience of the absence of rapid change elements during which it took them more than 4 times longer than the time it took with the aid of SMED.

Teaching - learning through experimentation, was preferred as compared to the traditional technique using slide shows. The students favored its use and showed a lot more motivation and interest in learning these techniques used in industry and manufacturing highlighting their flexibility and ease of adaptation to the constant changes that occur.

4.1 Original Contributions

The design and manufacture of a machine simulator, which allows the student or operator, to experience real work processes with real materials on real machines has been a breakthrough.

The person receiving the training does not have to interpret that the simulator pieces represent actual parts, work is done with real parts at all times. The same applies to the process and machines, no imagination is

necessary; students are faced with the everyday reality of an industrial process.

The control and monitoring of pressure is real and it is possible to vary it to avoid excessive consumption of pressurized air, generates higher cost in the operation of the process. Rapid change in a machine of such small dimensions is another contribution that helps make it a versatile and lightweight simulator. The two safety valves can minimize the risk of a student getting hurt while operating the machine.

Most clamping devices securing the machine, tooling and controls were specially designed for this simulator. There are no similar parts on the market. Nearly all parts of this simulator were subjected to a coating of zinc and then chrome, increasing corrosion resistance.

There are physical and virtual simulators. The former are activated by means of a personal computer and are as sophisticated as cockpit training for pilots and astronauts. Physical simulators, range from toys or games to actual machines that exist in industry. Our proposal is closer to the latter.

The machine is small, light and versatile, with the possibility of exchanging various types of dies: for cutting, stamping, bending and punching. The simulator allows us to work with the actual product, but with a reduced in size, which helps to control waste, even during training. The product obtained is real and tangible, the simulator works with real processes, similar to those used in industry, in comparison to what could be achieved with a game process. Theoretical knowledge is transferred into practice by means of a lean manufacturing process simulator, highlighting quick-change tooling in this particular case.

Students are attracted by the simulator. The experience of practical knowledge, makes them participants in their own training. However it is important to note that training, no matter where it is held or by what means, does not bear fruit if the skill taught is not practiced regularly. Without continual practice, skills atrophy [7]. This machine allows for regular training, within a budget.

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Education in the Transit: Analysis of Economic-Driving Program Implemented in a Public Transport Bus Company

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Abstract

The growing number of motor vehicles in urban areas has generated negative impacts on costs for users and bus operators due to congestion and the increase in travel time. Furthermore, transport sector is a significant user of energy, especially fuel, and a great responsible for greenhouse emissions. In order to mitigate these externalities, transport companies try to incorporate into their processes innovative tools and best practices in management, like the so-called economic-driving. The economic-driving seeks to reduce fuel consumption, greenhouse emissions and operational costs. This paper aims to present the results of an economic-driving program implemented in a public transport bus company in Brazil, in the period of 2010-2016. The methodologies used were exploratory, descriptive and case study. The results showed a reduction of fuel consumption by 786.336 liters. The analysis of the consumption of brake linings in eleven buses, running the same itineraries by the same drivers, decreased 47.46%. Based on the Embrapa's methodology for the calculation of greenhouse emissions the company stopped emitting 86,757.36 kilo grams of CO₂ in the atmosphere. In conclusion, the case study confirmed the feasibility of applying economic-driving strategies and the economic and social advantages with the program for the company.

Keywords: Public transport; Economic driving; Environmental impacts; Costs reduction

1. Introduction

The growing number of motor vehicles in urban areas has generated negative impacts on costs for users and bus operators due to congestion and the increase in travel time. Furthermore, transport sector is a significant user of energy, especially fossil fuels, and a great responsible for greenhouse emissions. In order to address these concerns, a vast number of researchers, public and private institutions, of various continents, are involved in the debate seeking to find out what actions need to be undertaken to meet solutions (Rezvani et al., 2015; Matas et al., 2017; Wang and He, 2017).

The studies of Urban Land Institute and Cambridge Systematics, Inc. (2009, p.1) affirms that transport greenhouse gas (GHG) emissions "are the result of the interaction of four factors: vehicle fuel efficiency, the carbon content of the fuel burned, the number of miles that vehicles travel, and the operational efficiency experienced during travel." Based on that statements, the studies indicated four basic approaches for the development of strategies for the reduction in GHG emissions. Are they:

• Vehicle Technology - Improving the energy efficiency of the vehicle fleet by implementing more advanced technologies.

• Fuel Technology - Reducing the carbon content of fuels through the use of alternative fuels (for instance, natural gas, bio fuels, and hydrogen).

• Travel Activity - Reducing the number of miles travelled by transportation vehicles, or shifting those miles to more efficient modes of transportation.

• Vehicle and System Operations - Improving the efficiency of the transportation network so that a larger share of vehicle operations occur in favourable conditions, with respect to speed and smoothness of traffic flow, resulting in more fuel efficient vehicle operations.

The economic-driving program concentrated on the approach vehicle and system operations, having advantage of new vehicle and fuel technology available, vehicle maintenance and personal training. The objective of the program is to decrease GHG emissions, fuel consumption and operational costs. Moreover, the strategies used sought to avoid accidents, stress to the drivers and, as a consequence, to improve work environment and the level of service to the users (Ma et al., 2012). The program works on three main topics: the driver skills and training, the vehicle technology and maintenance, the fuel quality and the routes.

Economic-driving can be applied to all kinds of transport means, particularly those who depend on fossil fuel as energy source. Pollution is one of the main aspects that are in focus, legislation and the general concern about the economy of fossil fuels. The petroleum products, when burned, emit particulates and gases that negatively impact the planet's ecosystem and human health (IMTT, 2014). Moreover, Governments and transport companies, moved by the market and competitiveness or seeking for social efficiency and financial stability, are constantly searching for alternatives to reduce costs and improve the organizational processes (De Borger and Proost, 2012; Anas, 2012).

This paper aims to present the results of an economic driving program implemented in a public transport bus company in Brazil, in the period of 2010-2016. It highlighted the way the economic-driving can reduce costs for a bus company, emphasizing a practical application using experimented techniques of economic driving program (Kim, 2016; Allis and Fraga, 2017). The study can be justified based on its strategic and environmental value. The rationalization of fossil fuels is relevant as they are non-renewable fuel sources and in addition, directly influences the environment and pollution, by burning it (Brand et al., 2013). Furthermore, it becomes an item of great impact on the results of the companies because diesel oil consumption takes large share of the total costs.

The studied theme is of high concern to managers, considering that the consumption of less fuel,

maintaining the same mileage, means raising productivity, what present positive outcome for the business. For administration the relevance is to contribute to the sharing of knowledge through the organization, making them more sustainable on the economic and environmental point of view. It is also important to disseminate the commitment to environmental issues to the employees, either through sustainable practices in the production process or encouraging other projects linked to sustainability, the so-called environmental responsibility. These values will cross the gates of the company and reach society (Holden et al., 2013). The methodology used for the study was: exploratory, descriptive, documentary and a case study. The study was conducted in an urban transport company, founded in 1969 in the city of Lages, Brazil. It has 240 employees, 57 buses operating on urban transport, traveling on average 260,000 kilometers and carrying an average of 550,000 passengers per month. The company is positioned in the urban transport market as a public concessionaire, got through bidding of Municipal Public Power. The study was performed in the traffic division. The data were collected from documents and management reports. Eighty drivers participated in the fieldwork. The fuel used in the engines of the bus fleet is the diesel S-1800, which has

been improved over the years, since the Brazilian Federal Government started to invest to use cleaner energy sources.

It was developed parameters to calculate the volume of spared fuel based on the numbers of thirty-eight vehicles, operating at a fixed line, by averaging the consume of each bus during the year 2008-2009. To calculate the amount of CO₂ that the company no longer pumped into the atmosphere it was used the parameters provided by Brazilian Company for Environment and Agriculture Research (EMBRAPA - *Empresa Brasileira de Pesquisa Agropecuaria*). It was calculated the volume of brake linings consumption using Excel spreadsheet to compare the expense volume before and after the implementation of the economic driving program.

2. Passenger Urban Transport in Brazil

The urban public transport by bus is an essential service to the Brazilian population. In the last decade it has required improvements to the quality of its services in order to meet the needs of users. This happens especially given the increasing use of private individual transport, which can be considered unfeasible both in socioeconomic and in environmental conditions for cities that want to develop in a fair and sustainable manner (Cooper et al., 2014).

The bus is probably the most widespread collective mode of transport worldwide. This is related to its flexibility, its ability to adapt to different demands, its simple technology and its ease of changing or creating new routes. In addition to the low cost of manufacture, implementation and operation when compared to other high capacity transport modes (Börjesson el al., 2017). The urban transport systems of Brazilian cities have a number of different types of vehicle operating passengers transport services. There are several manufacturers in the bus market and, consequently, competition becomes increasingly fierce. Every year there are new standards for vehicles being sold in the market due to the technological innovations proposed by the constructors (Corazza et al., 2016).

According to Gonçalves (2014) Brazilian cities face numerous problems related to urban transport what affects the standard of living for its citizens, such as: loss of mobility and accessibility, traffic congestion,

increasing environmental impacts of transport, greater travel times. Urban public transport systems, despite some major investments in specific cities or areas, it remains insufficient to meet the growing demand and has experienced cyclical crises mainly to the mismatch between costs, rates and revenues, as well as the shortcomings in the management and operation.

To reverse this situation it is necessary a revision of the current model of urban transport in the Brazilian cities, providing better mobility options, along with higher overall system efficiency. In order to achieve such results, public policies should be adopted to ensure: (1) better standard of living for all sections of the population, translated into decent transport, traffic safety and accessibility for carrying out the essential activities of modern life (Nævestad, Elvebakk, Phillips, 2017); (2) availability of an integrated transport network, working with social and operational efficiency, with effective priority to collective means; (3) high standard of environmental management, controlling the level of air pollution and noise (Schein, 2003).

2.1 Sustainability in Transport Operation

The transport sector has attracted the attention of the international community for being pointed as one of the biggest responsible for the intensification of global warming and its adverse effects on the earth's environment (Santos et al., 2010). Carbon dioxide (CO₂) is one of the most significant pollutants harming the earth's ecosystem. The emission of these gases cause the so-called "greenhouse effect ", what influences the rise of the average earth's atmosphere temperature. Diesel oil is a non-renewable source of energy. The process of burning fuel in a combustion engine, produces gases, vapours and particulate, and they are launched directly into atmosphere. The diesel emissions have the gas carbon monoxide, nitrogen oxides, hydrocarbons, sulfur oxides and particulate (black smoke), which contributes to increase greenhouse gases (Lee and Madanat, 2017; Kishimoto et al., 2017).

When 1 liter of gasoline gets to the gas station and even before combustion, it has already issued to the atmosphere 507 grams of CO₂. Similarly, 1 liter of diesel oil before being completely converted into energy in the engines already issued 510.4 grams of CO₂. Adding the CO₂ equivalent emitted from the burning of these fuels, 1 liter of gasoline emits a total of 3.65 pounds CO₂ equivalent and 1 liter of diesel 4.01 pounds CO₂ equivalent (EMBRAPA, 2009).

According to EMBRAPA (2009), data calculated on the basis of information provided by a bus manufacturer, in a 100 kilometres journey the diesel vehicle releases 29.69 pounds of CO_2 equivalent into the atmosphere. These values corresponds to the greenhouse gases emitted by industry in the extraction, refining, processing and transportation associated with the fuel, in addition to all the carbon dioxide produced in burning the fuel. A flex vehicle (engine technology able to use gasoline or ethanol fuels) that used pure gasoline emits, on the same distance, 35.10 pounds of CO_2 .

Government institutions together with transport sector conducted studies in urban public transport in the major cities of Brazil searching for alternatives in order to change the energy sources for more sustainable solutions (Lanzoni et al., 2011). The studies concentrated on three main focus: the emission of local pollutants, including heat; the contribution of emission to the greenhouse effect, especially CO₂; and the alternative fuels in public transport by bus seeking to encourage experiments with bio diesel, mixture of bio diesel and ethanol, CNG and hybrid electric technologies (Burke and Zhu, 2015).

A first evidence of the studies was the confirmation that the set of renewable and non-polluting energy sources are not enough and are not even adapted to the automotive market for use on a large scale, despite the steps already taken towards hybrid and electric vehicles, what are more efficient on energy consumption and non-polluting (Goodwin, Dargay, Hanly, 2004). Therefore, it is required more investment in research and development to grow in technologies solutions (Monzon et al., 2017). However, the problems about energy use are already on the table of managers. The immediate solution is to seek sustainable alternatives whether through adoption of available technological or management and processes innovations, or better, the combination of both.

Furthermore, due to the fierce competitiveness, one of the great challenges of government and transport companies is, on one hand to generate revenue and, on the other hand to reduce operational costs in order to guarantee the financial stability and to offer lower costs to the users (Gonçalves and Novaes, 1996). Studies and practical experiences show that the correct way to operate a vehicle reduces fuel consumption, providing financial savings for the companies and safety to the drivers and users, what may increase their sustainability (Verband Region Stuttgart, 2006). The environmental responsibility of organizations is based on sustainable growth that respects the environment (Araghi, Van Wee, Kroesen, 2017). According to Trennepohl (2009), environmental liability is the set of attitudes, individual or organizational, focused on the sustainable development of the planet. That is, these attitudes should take into account the adjusted economic growth to environmental protection today towards to guaranteeing sustainable life to future generations (Li et al., 2017).

2.1 Economic Driving

The economic driving tools includes a set of techniques that provides reduced fuel consumption, increases life for the vehicle component's, and seeks greater safety for the drivers and for the traffic (Luijt et al., 2017).

Fuel consumption in Brazil in 2012 increased 6.1% over the previous year, totaling 129.6 billion liters. There was an increase of 7 % in the consumption of diesel oil in the same period: from 52.2 billion liters to 55.9 billion liters (ANP, 2013). According to Silva (2001), the transport sector is responsible for 76% of the total consumption and, from this number, road transport takes 97%. The challenge of reducing this level of diesel oil use is justified considering the environmental impacts of greenhouse gases, and also due the trend of world oil reserves depletion.

Besides the environmental claims, managers of different organizations faces day by day great difficulties to reduce their production costs and to increase profitability, what is not different for transport companies that have on the top of their costs the diesel oil. Considering there are no longer fast perspectives in the horizon for large-scale replacement of fossil fuels, the rationalization is of great value for the economic balance in transport companies. The cost management works to provide information on opportunities to improve the economic results performance for the companies (Ito and Managi, 2015).

An important technological innovation alternative for transport companies to improve financial performance is to find a way to raise the average mileage with the same amount of fuel consumption. The economic driving aims to decrease the average fuel consumption and to increase the life for the vehicle

The driving skills of the driver, according to obtained guidance and instructions, personal habits acquired during his work experience, determine in great way the fuel consumption of the vehicle. Points out some techniques for economic driving: (1) take advantage of the inertia of the vehicle; (2) using the tachometer to drive; (3) always travel with the vehicle in gear; (4) changing gears with ideal speed; (5) using the vehicle power only when necessary; (6) driving with traffic forecast; (7) using the brakes correctly; (8) do not use intermediate accelerations; (9) using the least number of possible gear changes; (10) maintain constant speed.

According to IMTT (2014), energy efficiency reference values for each vehicle and outside factors affecting the vehicle, the practice of an economic and eco driving, require the adherence to certain important principles. It is considered an economic-driving, the practice of driving a vehicle using the least amount of energy, with the lowest mechanical wear and the lowest environmental impact. The economic-driving depends on some key factors: (1) driving skills and manner; (2) choice of the route; (3) time savings; (4) the vehicle specifications; (5) vehicle maintenance and best practices (Bogoni, 2009).

The reduction of fuel costs can only come into practice when the professional driver applies the knowledge of economic-driving techniques. Therefore, training the drivers is essential. For acquiring the knowledge it is necessary to take specialised theoretical and practical lectures, applying a methodology easily understood by the drivers. According to Bogoni (2009, p. 29), in Brazil from the mid 1980s the training of professional drivers has been considered as necessary and strategic by transport companies. In the past the characterization of a good driver was only related to those who were not involved in traffic accidents. This situation changed as time passed because of the need to involve the drivers on the responsibility to reduce the operational costs.

For Spitzer (1997, p.175), nothing can distinguish better the exceptional companies from the mediocre than the commitment to training the staff. The most successful companies in the world are those that invest more in training their employees. Successful companies described by the author differ from others, when identifying new technologies, investing in searching for competitive advantages on several fronts, including that of his intellectual capacity and its dynamics. This environment dynamic is related to how the space where, considering knowledge and information became basic value for any organization.

The drivers have the power to decide to apply the knowledge acquired according to their motivation to perform their tasks, considering the human motivation refers to why people behave in a certain way. According to Chiavenato (1993) individual motivation for carrying out certain task is evidenced by acts and practices and the behavior is also a result of the work environment. The behavior depends not only on past or the future, but the current environment a person is works and his psychological perception of it. The force mentioned by the author is confirmed when the bus driver shows commitment to the company where he works, and also receives a good working environment, even challenged by the targets, he seeks to fulfill

them.

In their studies Oliveira e Orrico Filho (2004) affirms that the diesel fuel has a significant share of transport fare for the users. Therefore, the authors recommend more attention both in the measurement of fuel consumption, regulating the engines, improving technology, and implementing the national guidelines to improve the productivity and quality of transport program.

In order to conduct a performance analysis to measure whether the objectives are being achieved or not the company needs to take the historic series of individual average fuel consumption of each vehicle associated with the average fleet before the starting of the drivers training in order to compare them with fuel consumption after the completion of the program. In this way it can be established an indicator for the monitoring of the application of economic-driving techniques. This analysis can also be used for planning and for assisting decision making (Luijt et al., 2017).

3. The Case Study Analysis

The findings pointed out that each of the eighty drivers involved in the fieldwork drive the vehicle in a different way, resulting in different level of fuel consumption. Moreover, it was observed that the second highest operational cost is related to fuel consumption. According to the company managers, it was used a special fuel to avoid releases of greenhouse gases, that's way fuel prices raised. The company implemented the economic-driving program in mid-June 2009 and gradually introduced all drivers till the month of December 2009. The experience that its success depends on some key factors: (1) driving technique; (2) choice of the route; (3) time savings; (4) vehicle standard and technology; (5) vehicle maintenance and best practices (Bogoni, 2009).

Based on the economic-driving features of Bogoni (2009), the company gave the following instructions to the drivers:

• The vehicle with electronic engine increases the average km/l when using the inertia in favor, with gear and no acceleration, because it enters fuel consumption zero regime in this condition.

• Using the tachometer to drive: it is a device on the dashboard to provide information to the driver about the engine rotation - in flat topography the driver should use higher gear and lower rotation.

• Always travel with the vehicle in gear, because the braking system will be required within a normal operating condition, with normal slit.

• Making changes gears with ideal rotation, guided by the tachometer: the driver must make changes gears according to the ground, using in flat topography and slopes the lowest possible rotations, and when going up hills use higher rotations and taking advantage of the full power of the vehicle.

• Using vehicle power only when really required: the vehicle's power should be used as little as possible because this operating condition greatly increases fuel consumption; the torch is the ideal track to achieve the lowest fuel consumption.

• Using traffic prediction guidance: the urban roads present several situations that require the vehicle to be long stopped including traffic lights, preferred roads, roundabouts, traffic congestion; the driver must use good traffic forecast to remain the shortest time possible under those conditions, avoiding slow gear for the vehicle what raises fuel consumption.

• Using the brakes correctly: the service brake must be used only to the vehicle stops or emergency situations; for speed corrections should be used other resources such as deceleration; it is also important the use of the brake motor right way, because the engine brake has maximum effect in high regime of rotation;

• Not using intermediate accelerations: intermediate rotations or raises are unnecessary because the vehicle is not in gear, so it does not contribute to power and speed.

• Using the lowest possible number of gear changes because when changing gear the engine stops the power between the gearbox, increasing the fuel consumption: using appropriate traffic forecast the driver identifies the real need to make the gear changes;

• Maintaining constant speed whenever possible, avoiding speed oscillations that forces higher engine rotations.

Table 1 shows a significant reduction of fuel consumption in the period of 2008 to 2016, and the amount of litres of fuel saved per year, resulting of the applied program in the company.

Year	Km run by the fleet	Fuel consumption (liters)	Average fuel consumption km/l	Saved fuel (litres)	Saved money (R\$)
2008	3,126,395	1,305,766	2.39		
2009	3,082,860	1,258,885	2.45		
2010	3,134,396	1,174,390	2.67	102.454	183,653.02
2011	3,076,084	1,155,216	2.66	103.627	184,526.65
2012	3,028,129	1,122,401	2.70	113.537	208,777.65
2013	3,148,558	1,175,829	2.68	109.446	232,125.35
2014	3,164,540	1,173,580	2.70	118.546	268,399.99
2015	3,242,316	1,191,735	2.72	121.484	317,984.37
2016	3,096,478	1,145,075	2.70	117.242	328,441.74
TOTAL	28,099,756	10,702,877	2.63	786.336	1,723,908.77

Table 1: Results of economic driving program in the period of 2008 to 2013

Source: The studied company.

The data in Table 1 shows that in 2009, when the economic-driving program started, the vehicle began to run higher mileage per liter of fuel. In 2010 when all trained drivers were working, the average km/l rose further, stabilizing in the third year and going up even more in the fourth year. In this case study the saved fuel was calculated using the established parameters based on the consumption of thirty eight vehicles running in the same itinerary, calculated by averaging the bus of each fixed itinerary, during the year 2008-2009.

Table 2 shows the volume of CO_2 that have ceased to be emitted into the atmosphere after the introduction of the economic driving program. According to EMBRAPA (2009) and the data provided by the bus manufacturer, every trip of 100 km made by a diesel vehicle releases 29.69 kg of CO_2 to the atmosphere.

Therefore, the volume of diesel fuel saved could cover additional 292,210.71 km, what means that the studied company avoided the emission of a volume of 86,757.36 kg of CO₂ into the atmosphere in the period of 2010 to 2016.

Year	Average fuel	Saved fuel	Km that could be run	CO ₂ volume not released to
	consumption km/l	(liters)	using the saved fuel (Km)	atmosphere (Kg)
2010	2.67	102,454	38,372.28	11,392.73
2011	2.66	103,627	38,957.52	11,566.49
2012	2.70	113,537	42,050.74	12,484.86
2013	2.68	109,446	40,838.06	12,124.82
2014	2,70	118,546	43,905.92	13,035.67
2015	2,72	121,484	44,663.23	13,260.51
2016	2,70	117,242	43,422.96	12,892.28
	TOTAL		292,210.71	86,757.36

Table 2: Volume of CO₂ that have not been released to atmosphere with the introduction of the economic driving program

Source: from the authors

Moreover, it is worth noting the economic aspect: the organization saved in the studied period R\$1,734,971.75 (R\$2.2064/1 X 786,336 liters) values calculated using the price for a liter of diesel in February/2014. Likewise, it was observed there was a reduction in the consumption of replacement components and brake lining for the fleet.

Bus	Km year before	Brake lining	Km year after	Brake lining consumption
number	starting the program	consumption	starting the program	after starting the program
24	56,992	24	43,843	8
34	20,371	8	26,191	4
37	37,003	16	22,829	0
45	61,691	24	61,099	16
46	45,406	16	45,936	4
47	63,441	24	59,638	8
48	72,469	36	57,561	12
51	49,775	12	48,492	8
52	50,342	36	50,401	24
64	66,274	24	63,132	20
65	50,456	16	65,514	8
Total	574,220	236	544,636	112

 Table 3: Brake lining consumption in the period of 2010

Source: from the authors

It was found that the brake lining consumption in eleven buses compared to the previous year and after the economic-driving program, operating in the same itineraries and with the same drivers, reduced 47.46%. Furthermore, considering there were no replacement pads for the buses, it was also reduced time working for the maintenance. The tire consumption also receives less effects of friction of the brake lining components.

The results showed that the introduction of adequate training and efficient techniques of economic management it can reduce fuel consumption, replacement components and maintenance. Together to these advantages, the company consequently reduced the amount of CO₂ released to the environment, contributing to environmental responsibility and to avoid the harmful effects of fossil fuels.

In terms of economic results, the theory confirms the findings of the case study in the urban transport company. A significant reduction of fuel was found when the driver applied the economic driving techniques. The professional driver decides the way he would drive the vehicle but it is the companies' responsibility to motivate and monitor the operation in order to get the sustainable outcomes. Based on what Chiavenato (1993) wrote, it is evident that human behavior depends on the subjectivity of each person, and there is a direct relationship with everyday reality, which can directly influence the person considering his psychological state, since the human being reacts differently to the own present moment. However, the organization should take the responsibility and be concern that the environment and its own staff should not significantly affect the desired result. In this cases training is essential. At the beginning of training the company had the natural resistance of the human being to change. Therefore, along with the economic driving program were established criteria for awards and bonuses for attained goals by the drivers. Then, gradually the drivers started to adhere to the program. Today on average 91% of the drivers received awards and existing bonus.

The overall average fuel consumption presented by the fleet in 2008 was 2.39 km/l. That meant the vehicle had underperformed in operation in relation to the performance reported by the bus manufacturer. In the following year, in 2009, when started the training for the drivers, it was observed a small increase to 2.45 km/l. In 2010, the average fuel rose to 2.67 km/l and remained with the average through the year 2011. In the year 2012 was the peak performance of 2.70 km/l, which had the best performance, recorded to this day, reinforced also because the introduction of new buses to the fleet. In 2013 the average consumption returned to keep in 2.68 km/l, meeting with this result the company's goal, keeping the average diesel consumption reduction of 100,000 liters/year.

3. Conclusions

This study confirms that investments made in training and monitoring contribute to the positive outcome of the organization. It was seen reduction in operating costs that directly impact on the financial balance. Furthermore, economic-driving program brings tangible benefits in the economic and environmental aspects for urban passenger transport companies, when enable the control of fuel consumption, the reduction of brake lining consumption and the monitoring of emissions CO₂ released into the atmosphere. Moreover, qualified professionals can deliver better services for the population.

Professional drivers face in their daily work the challenge of safely carrying passengers with comfort and

courtesy in the heavy traffic of urban centers, requiring careful attention. In order to improve the working environmental conditions, seeking to reduce their operating costs, the transport companies need to incorporate in their processes innovative ways and best practices in management. The case study proved that economic-driving program, when applied by skilled drivers, increases the average fuel consumption per kilometer per vehicle, thus consuming less fossil fuels, increasing company profitability and preserving the environment.

Finally, it is well known that motor vehicle impacts negatively on air degradation in urban centres since it launches every day huge amounts of pollutants into the atmosphere (Ma, Xie, Han, 2012). In spite of several meetings being held worldwide trying to meet agreements to reduce the emission of air pollutants, seeking the preservation of the environment and the reduction of greenhouse gases effects, transport sector still remain as one of the greatest contributor to these effects. Therefore, this discussion should be among the priorities of transport managers, as the degradation of the environment does not meet the needs of sustainable organizations. We all have direct responsibilities to the preservation of the environment, and we all are committed with the future of the planet we want to leave our children and grandchildren.

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