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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-5 of IJIER*** which is scheduled to be published on **31st May 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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Traditional Birth Attendants and Childbirth in Kenya: A Case of Kitui West Sub County

[1]Paschalia Mbutu, [2] Dr. Wanjiru Gichuhi, [3] Dr. Grace Bosibori Nyamongo
[1]PhD Student African Women Studies Centre, University of Nairobi,
[2]Senior lecturer Institute of Population Studies and Research, University of Nairobi,
[3]Research Associate/Lecturer African Women studies Centre, University of Nairobi, Kenya

Abstract

*The first objective of this research was to explore the role played by traditional birth attendants (TBAs) during pregnancy and childbirth. The second objective was to establish perspectives of pregnant women regarding the role played by TBAs during childbirth. Eight TBAs out of 12 were selected using simple random sampling technique. These 8 TBAs were drawn from the environs of 10 sampled health facilities. To calculate the sample size for the pregnant women to be interviewed about their perspectives towards TBAs from the 10 sampled health facilities, this formula was used, 1230 x 15/100=184.5 rounded up to 185. **A**ccording to 2009 census, the population of women at child bearing age (15 – 49 years) was 1230 in Kitui West Sub-County (KNBS et al.; 2009). The final sample size for pregnant women was 187 as shown under the discussion on sampling techniques. An in depth individual interview guide was used to gather information from the 8 TBAs and 165 pregnant women. Unstructured interview guide was used to gather information from 22 respondents who formed focus group discussion (FGD). To make a meaning from the raw data, it was transcribed and emerging themes and patterns according to the objective of the study were picked. The Chi-square test analysis showed that more than a half of the women preferred to deliver at home assisted by a TBA. ($\chi 2=1.572$; df=2; p=0.036) where p=0.05. This was confirmed by the fact that 37 percent out of 135 respondents who attended ANC clinic and 90 percent out of 30 respondents who did not attend ANC clinic delivered at home assisted by TBAs.*

Key words: TBA, pregnant woman, childbirth, delivery

1.0 Introduction

TBAs undertake a vital role in communities where majority of women give birth at home. For instance in Asia, 41 percent of births take place at home assisted by TBAs (Falle, 2009). Pregnant women in Indonesia prefer to be assisted by TBAs instead of a skilled midwife because the latter are handy where resources are scarce to facilitate the woman to seek health facility delivery (Kumbani, 2013). Besides, TBAs offer psychological support, they are available and are good at empathizing with the women giving birth. Majority of women in the developing world prefer to give birth at home. For instance between 60 and 80 percent of deliveries take place at home assisted by TBAs. In Mexico TBAs conduct forty five percent of

deliveries at home (Ebuehi et al., 2006). In India, records of deliveries from health facilities indicated that majority of births happened at home with the assistance of a TBA (Milmo, 2013). In Sub Saharan Africa (SSA) approximately half of deliveries are attended by TBAs (WHO et al.; 2010). In Sierra Leone, TBAs conduct 70 % of deliveries and give support during antenatal period while in south-western Nigeria, TBAs conduct 65 % of deliveries at home (Ebuehi et al., 2006). In Uganda, majority of women, especially in the remote areas prefer to be assisted by TBAs during delivery (Tuguminize, 2009). In Kenya which is the country of study, 39 % of women deliver at home assisted by a traditional birth attendant (KNBS et al.; 2014).

1.1 Who is a Traditional Birth Attendant?

A TBA is a person among community members who conducts deliveries. This skill is acquired by observing other TBAs assisting deliveries or simply learned by doing. Since a TBA is an integral part of the community, she is aware of belief systems regarding childbirth in that specific community. She is an important person as regards to childbirth (Choguya, 2014). The role of a TBA therefore, should not be underestimated since she is the one who accompanies pregnant women to term. She plays the role of counselor and because of this relationship a bond is created whereby the pregnant woman entrusts her cares to the TBA concerning issues of childbirth. Usually it is the TBA who determines where the delivery will take place; either at home or in a health facility (ibid).

1.2 Research Objectives.

1. To explore the role played by TBAs during pregnancy and childbirth.
2. To establish perspectives of pregnant women regarding the role played by TBAs during childbirth

2.0 Study site

Kitui West Sub County which is the study site is one of the 16 sub counties in Kitui County. According to 2009 census, the population of women at child bearing age (15 – 49 years) was 1230 in Kitui West Sub-County (KNBS et al.; 2009). Health facilities were 261 with 3 County hospitals and 8 sub-county hospitals at the time of this research. According to the District Public Health Nurse in charge of the health facilities in Kitui West Sub County, there were 22 health facilities. Out of these facilities, 18 offered integrated maternal health care services.

3.0 Research methodology

3.1 Sampling technique

Out of 18 health facilities, 10 were selected using simple random sampling technique. Eight TBAs out of 12 drawn from the environs of the 10 sampled health facilities were selected using simple random sampling technique. To calculate the sample size for pregnant women within the 10 health facilities and their environs to cater for pregnant women who did not attend ANC clinic, the following formula was used 1230 x

15/100=184.5 rounded up to 185. This formula was based on the fact that, according to 2009 census, the population of women at child bearing age (15 – 49 years) was 1230 in Kitui West Sub-County (KNBS et al.; 2009). From each facility and its environs the researchers intended to interview 19 pregnant women which was arrived at by dividing 185/10 = 18.5, rounded up = 19 pregnant women. The researchers used the same formula of 15 percent to calculate the number of pregnant women who did not attend ANC clinic, thus; 19 x15/100 = 2.9, rounded up = 3 pregnant women from the environs of the sampled health facilities. However some of the health facilities were oversampled to compensate for the ones which had less numbers considering that the focus was women within gestation between 7-9 months which was a small segment among pregnant women. In the final end a total of 187 pregnant women were interviewed. These respondents comprised of 157 who attended ANC clinic and 30 who did not attend ANC clinic. The figure of 157 included; 135 respondents who were interviewed individually and 22 that formed FGD who were drawn from 2 health facilities within the 10 sampled health facilities. An in depth interview guide was used to gather information from individual respondents whereas unstructured interview guide was used to gather information from respondents who formed FGD.

To collect information from the TBAs to determine the role they played during pregnancy and childbirth, the following questions were asked:

1. Is there a time a pregnant woman plans to deliver in a health facility but later on changes and chooses to deliver at home?
2. According to your experience, can a pregnant woman deliver in a health facility against her husband's wishes to deliver at home?
3. Do you have prior link with pregnant women who come for delivery?
4. Are you aware of any problems that can occur during childbirth?
5. What happens in the event that the pregnant woman cannot deliver at home?
6. Do you give any advice about childbirth to pregnant/postnatal women when they come to see you?
7. In case there is a problem during labour or after delivery and family members are reluctant to take action, can you intervene?
8. Do you have further connection with the woman after delivery?
9. What do pregnant women say about delivering babies in a health facility?
10. Which category of women is likely to deliver at home and why?
11. Do you have any connection with nurses regarding your role as a TBA?

Individual pregnant women were asked; where they were planning to deliver their babies and where they finally delivered and the reasons for their choice. For FGD, the respondents were asked how they perceived the role played by a TBA during childbirth.

3.2 Data analysis

The raw data was transcribed to make a meaning. While emerging themes and patterns were identified, coded and categorized. To transcribe the raw data, the information was scrutinized and the main idea was

picked in relation to the objectives of the study. To interpret the data, qualitative and quantitative data was compared and validated. This was followed by indentifying concepts which were then grouped into themes according to the research questions. Finally, the information given was analyzed to explore the role played by the TBA during pregnancy and childbirth. Also the analysis included the perspectives of the pregnant women in respect of the role played by TBAs during childbirth.

4.0 Demographic characteristics of pregnant women

Women who attended ANC clinic

Respondents in the age bracket between 16 to 20 years were 25 out of 135(18 percent) while those in the age bracket of 21 to 25 and who were the majority totaled to 57(42 percent). The respondents who were between the ages of 26 and 34 were 44(33 percent). Respondents aged 35 and above were 9 (7 percent). Married respondents were 105(78 percent) while those who were single were 30(22 percent). One hundred and sixty three children were born within this category of women. Out of 163 children, 60(37 percent) were born at home assisted by TBAs. The rest of the children totaling to 103(63 percent) were the majority and were born in various health facilities. Analyzing the data further, it was observed that respondents within age bracket of 26-34 had delivered 31(37 percent) children at home assisted by TBAs out of all the children born totaling to 87. On the other hand those who were 35 years and above had delivered 21(70 percent) out of 30 children at home assisted by TBAs. These observations indicated that advancement in age coupled with childbirth experience was likely to influence women to deliver at home assisted by TBAs. These profiles of respondents are shown in table 1, page 6.

Table 1: Demographic characteristics of pregnant women

		N.	Percentage
Age	16-20-years	25	18
	21-25-years	57	42
	26-34-years	44	33
	35 & above years	9	7
Total		**135**	**100%**
Marital status	Married	105	78
	Single	30	22
Total		**135**	**100%**
Education level	No schooling	1	0.7
	Primary	86	63.7
	Secondary	39	28.9
	Tertiary	9	6.7
Total		**135**	**100 %**
Religion	Catholic	45	33
	AIC	41	30
	Pentecostal churches	49	37
Total		**135**	**100%**
Gestation period	7 months	43	32
	8 months	49	36
	9 months	43	32
Total		**135**	**100%**
Previous pregnancies	1st pregnancy	50	37
	1 – 2 children	63	47
	3 – 5 children	20	15
	6 – 8 children	2	1
Total		**135**	**100%**
Birth place of 163 children born to women interviewed	Home deliveries	60	37
	Health facility deliveries	103	63
135	**100%**	**163**	**100%**
Occupation	Small businesses	21	16
	Teachers	15	11
	Subsistence farming	58	43
	Housewives	15	11
	No occupation	26	19
Total		**135**	**100%**

Demographic characteristics of pregnant women

Women who did not attend ANC clinic

The respondents in the age bracket between 18 to 25 years were 8(27 percent) while those in the age bracket of 26 to 34 and who were the majority totaled to 12(40 percent). Respondents aged 35 and above were 10. Married respondents were 25(83 percent) while those who were single were 5(17 percent). The Number of children born by 26 respondents was 89. The largest number 81(91 percent) was born at home assisted by

TBAs while a small number, 8(9 percent) was born in various health facilities. The distribution of the respondents' characteristics of respondents is illustrated in table 2 below.

Table 2: Demographic characteristics of women who did not attend ANC clinic

4.1 Findings

Results

Interview with TBAs

Most of the respondents' responses were reported verbatim and the respondents were given pseudonyms to conceal their identity.

		No.	Percentage
Age	18-25 years	8	27
	26-34 years	12	40
	35 years & above	10	33
Total		**30**	**100%**
Marital status	Married	25	83
	Single	5	17
Total		**30**	**100%**
Education level	Primary	23	77
	Secondary	7	23
Total		**30**	**100%**
Religion	Catholic	10	33
	AIC	8	27
	Other denominations	12	40
Total		**30**	**100%**
Gestation period	7 months	6	20
	8 months	11	37
	9 months	13	43
Total		**30**	**100%**
Previous pregnancies	1st pregnancy	4	10
	1 – 2 children	10	33
	3 – 5 children	13	47
	6 – 8 children	3	10
Total		**30**	**100%**
Birth place of 89 children born to women who did not attend ANC clinic	Home deliveries	81	91
	Health facility deliveries	8	9
Total		**30**	**100%**
Occupation	Small businesses	17	57
	Subsistence farming	6	20
	Housewives	4	13
	No occupation	3	10
Total		**30**	**100%**

The following discussion highlighted the role played by TBAs during pregnancy and childbirth. To elicit responses the researchers used some questions as indicated below:

Is there a time a pregnant woman plans to deliver in a health facility but later on changes and chooses to deliver at home?

All the 8 respondents said that it was likely for a pregnant woman to plan to deliver her baby in a health facility and later change and deliver the baby at home. For instance Ng'anduna said:

> Yes it happens, sometimes labour can be precipitated and alter original plans of delivering in a health facility hence making the woman to deliver at home. There are other women who deliver on their way to a health facility. Some pregnant women can decide to deliver at home assisted by a TBA but if the TBA realizes that delivery cannot take place at home due to difficult labour, the pregnant woman is taken to a health facility by her relatives. A case in point was a woman whom I was assisting during childbirth. As I assisted this woman, I realized that labour was not progressive as expected. As a result of this experience, I accompanied her to the health facility where she underwent caesarean section because the baby's cord had coiled around the neck.

Additionally, Ng'atuva, one of the respondents shared her experience as indicated in the following extract:

> A woman might also change her mind to deliver at home instead of delivering in a health facility because of cordial relationship with the TBA and family members. Nevertheless, if complications arose during labour there was no option but to seek assistance in a health facility. For example, one of my clients had planned to deliver in a health facility but during labour she asked me to conduct the delivery. In the process, I realized that she was experiencing difficult labour so I decided to accompany her to the health facility where she delivered safely.

Ng'akalungu concurred with Ng'atuva and Ng'anduna that, it was likely for a pregnant woman to change her plan of delivering her baby in a health facility and opt to deliver at home. As she put it, "Women plan to deliver in a health facility but change to deliver at home because the home environment is favorable since there is support and concern by relatives. Some women will choose to deliver in a health facility when they realize that there is a problem that cannot be handled at home". Ng'andike and Ng'anzula held the opinion that, some pregnant women would change their plans of delivering their babies in a health facility because they thought TBAs were experienced and felt safe in their hands.

The respondents were asked if a pregnant woman could deliver in a health facility against her husband's wishes to deliver at home.

Ng'anduna, agreed that a pregnant woman could deliver in a health facility against her husband's wish. She cited a case where a husband insisted that his wife should be assisted by a TBA but the wife wished to deliver in a health facility. She said, "The pregnant woman came to my house and I walked her to the health

facility. I stayed with her in the health facility for 2 days till she gave birth and was discharged", concluded Ng'akalungu. However, Ng'akulikya maintained that the woman could deliver her baby in a health facility but the TBA had to intervene to persuade the husband to accept the wife's choice. Notwithstanding the views of the above respondents, the rest 5 disagreed with the above views and firmly maintained that a woman could not possibly go against her husband's wish. For instance, Ng'amuli affirmed that a married woman could not go against her husband's decision.

To elaborate this further, she cited the following case:

> A certain pregnant woman planned to deliver in a health facility but the husband refused to let her do so. She packed a few of her belongings and came to ask me to accompany her to the health facility. Since I did not want to cause a conflict in her family, I urged her to comply with her husband's directives. However I prepared her on how to await for the baby by having a new razor blade, clean cord ligatures for tying the baby's cord, a clean mattress and a clean bed sheet. I advised her to ensure that the baby's cord was tied 3 times and demonstrated to her how to separate the cord from the placenta. I also demonstrated to her how to deliver the placenta and how to examine it to ensure that there were no retained pieces of placenta in the uterus. The pregnant woman went back to her house and when she realized that she was about to deliver, she informed the husband and requested him to call a TBA. The husband went and never came back until the following morning without a TBA. Fortunately she delivered safely all alone at night.

Although Ng'andike felt that a pregnant woman cannot go against her husband's wishes, she believed that she had an obligation to convince the woman's husband to allow his wife to deliver in a health facility as she wished. Ng'anzula sharing similar views as well indicated that, though she believed a pregnant woman could not go against her husband's wish, she felt she could intervene in case of a need to facilitate the pregnant woman's referral to a health facility.

Do you have prior link with pregnant women who come for delivery?

Ng'andike and Ng'amuli pointed out that they had contact with pregnant women prior to conducting the deliveries. But they lamented that there were those women who came the last minute. For instance Ng'andike said, "I have contact with pregnant women, but there were those who came the last minute which was not good. When pregnant women come unexpectedly I might not know the position of the baby or the health status of the woman. When the position of the baby in the uterus and the health status of the woman are not known in advance, any advice given thereof can be limiting". Sharing her views on the same matter, Ng'amuli postulated that although she made contact with pregnant women, it was not on regular basis. She observed that some women came only when they were in labour but she assisted them. "It did not matter if we had any prior interaction or not, it was all about delivery", she said.

The rest of the respondents, like Ng'amuli, did have contacts with pregnant women but not always. Ng'anzula pointed out that sometimes women came when they were in labour and she assisted them. But she usually preferred to have women who had frequently been coming to see her because at least she knew

their situation better that was; the position of the baby in the uterus which gave her an idea of the type of delivery expected. She further observed that for the pregnant women who only came during labour, she could not know their condition in terms of the position of the baby in the uterus and the wellbeing of the woman. She shared a case of a woman who did not have prior contact to demonstrate how challenging the situation could be:

> I was called by relatives to assist a certain woman who was in labour. This woman had never come to see me before regarding her pregnancy. All the same I agreed to conduct the delivery because she was about to give birth. This woman had no money for transport in case of any eventuality, no clothes for the new born neither was there any food in the house. Little did I know that she was expecting twins which are usually complicated to deliver at home. The first twin was born without complications and survived but the second was born asphyxiated (difficulties in breathing) and died immediately after birth. The placenta was retained and the woman started bleeding excessively. Although I was able to deliver the placenta, the woman died immediately after that because she lost a lot of blood.

Four other respondents shared similar concerns with the above respondents regarding irregular contacts with pregnant women. These respondents maintained that their first contact with some pregnant women was when they were in labour or ready to give birth. Despite what has been said above, Ng'akalungu did not have any link with the pregnant women because she did not conduct deliveries anymore. She pointed out that TBAs were discouraged not to conduct home deliveries by Ministry Of Health, Kitui due to HIV/AIDS scourge. Nevertheless she conducted emergency deliveries to save life.

What happens in the event that the pregnant woman cannot deliver at home?

Ng'atuva and Ng'amuli would inform the mother in law who was expected to contact the husband of the woman who was in labour to organize for transport or come to a consensus on what to do. If the woman was not married Ng'amuli would take a step further and inform her mother to organize the logistics of going to a health facility. Ng'andike on the other hand would share the problem with the husband because he had the final say about what was to be done next. "In some cases I have realized that neither the pregnant woman nor the husband have prepared for any emergency. I have observed that they start borrowing money for transport when the woman was really in danger", she said. Ng'akulikya shared similar views by contending that many a times the woman including family members were not usually prepared for such eventualities because sometimes it took quite a while to get money for transport.

Ng'anduna and Ng'akulikya said that they would inform the family members; give them the reasons why the woman could not deliver at home and accompany the woman to a health facility. For Ng'akalungu, she would give the report to the relatives of the pregnant woman so that they organize for transport if the health facility was far. "Otherwise if transport was not available and the health facility was within reach, I and the relatives of the pregnant woman, we would walk with her slowly to the health facility. Sometimes I use my own resources if I find that the woman had not saved any money for contingency" said Ng'akalungu. If the

woman could not deliver at home, Ng'andeveimwe would refer her to a health facility or call the nurse to come for assistance. "However referral in such a context has its challenges. It is possible to refer the pregnant woman to a health facility only to discover that she was not prepared for such an eventuality. This is evidenced by the helter - skelter way of doing things and sometimes life is lost" she said.

Do you give any advice about childbirth to pregnant/postnatal women when they come to see you?
Ng'anduna and Ng'akalungu had elaborate accounts on the advice they gave to pregnant women. For instance Ng'anduna advised antenatal women on personal hygiene, the best sleeping position to avoid making the fetus uncomfortable, to avoid strenuous work and to avoid standing for long hours. If her legs were swollen, she took silks from green maize, boiled it and gave the fluid to the woman to treat the condition. She palpated the abdomen of the woman to know how the fetus was lying in the uterus. In case she found the fetus was mal-positioned, she performed manual positioning to bring the fetus to a normal position. She also listened to the foetal heart. Ng'anzula also palpated the women and gave them advice about personal hygiene and eating balanced diet such as beans and maize. Ng'akalungu encouraged antenatal women to attend ANC clinic and examined them to check if they were anaemic. Her full account was captured as under:

> In the case of anaemia, I advised the woman to eat more of nutritious food such as milk, meat, vegetables, eggs, beans and fruits. For swollen legs, I advised her to rest her feet on an elevated position like on a stool to increase blood circulation. If a woman had varicose veins, I referred her to a health facility because there was a danger of bleeding profusely if the veins were pricked.

Like Ng'anduna and Ng'akalungu, Ng'andeveimwe advised antenatal women about the best position of sleeping to avoid stressing the fetus. Like Ng'anduna, Ng'andike also palpated the pregnant woman's abdomen to ascertain the position of the fetus and then advised the pregnant woman accordingly. Ng'atuva on the other hand advised antenatal women to save some money for transport in case of any emergencies such as early ruptured membranes. Ng'akulikya informed pregnant women that ruptured membranes was a dangerous sign in pregnancy since it could cost the baby's life and gave them the signs of how they would recognize this condition.

Ng'amuli advised postnatal mothers to drink milk after delivery to relieve abdominal pain which occurs after delivery. Ng'anduna taught postnatal mothers about personal hygiene, the type of food (milk, beans, meat, maize, sorghum, and finger millet) they should eat in order to increase blood supply in the body to replace what was lost during delivery and to increase breast milk. She further advised them to exclusively breast feed the baby for six months. She explained the postal mother that breast milk was the best for the baby. She told her to keep the baby warm at all times in order to avoid pneumonia as well as keeping the baby clean. Ng'akalungu also advised the postnatal women to keep the baby warm always. She taught them the best way to position the baby while breastfeeding and to exclusively breastfeed it for six months. She recommended them to feed well in order to increase breast milk.

Ng'andeveimwe she advised postnatal women against holding the baby upside down. She also advised them to avoid bathing the baby few days after delivery and only use cotton wool dipped in oil to wipe the body and to keep it warm all the time. Similar ways of bathing the baby and keeping it warm as mentioned above were also shared with pregnant women by Ng'andike. Ng'andike advised postnatal mothers to take panadal tablets in case they were in pain and she taught them how to keep the baby warm while Ng'akulikya listened to their complaints and advised them accordingly.

In case there is a problem during labour or after delivery and family members are reluctant to take action, can you intervene?

In answer to this question, Ng'andeveimwe shared her experience of such situation as under:

> A certain pregnant woman whom I had not known in advance came to me when her time for delivery was due. After a brief examination I realized that I was not able to conduct the delivery. When I brought my concern to the family members they seemed not to bother. Faced with this situation, I decided to take the responsibility and accompanied the woman to a health facility where she eventually delivered safely.

Four other respondents said they would involve mothers in law, husbands or parents and make sure the pregnant woman was taken to a health facility. For instance, 4 respondents concurred that they would talk to a family member especially mother in law and the husband or the parents if the woman was not married and inform them why the pregnant woman should be taken to a health facility. In case they refused to take action, Ng'anduna would involve the village administration although she has never involved the village administration because the family members usually listened to her. Ng'atuva would involve the village elder and the chief if need be if no action was taken. If no foreseeable action was forthcoming the four respondents indicated that they would use their own resources. In this regard Ng'anduna said, "If the family members are not supportive especially when the husband disowns the pregnancy, I will use my own resources to help the woman but we agree on how she will refund whatever money I spent". Ng'akalungu shared the same views with Ng'anduna. She pointed out that if family members were not willing to transfer the pregnant woman to a health facility, she would use her own resources to ensure that she got to a health facility for help. Later she would negotiate with the parents on the modalities of paying back her money. Ng'atuva would also use her own resources to assist the woman. She did not talk of reimbursement of the money she would have used to help the woman.

Ng'andike said she would inform the family members about the situation and insist to be told what should be done while Ng'anzula would do everything to ensure that the mother and the baby's lives were safe. She postulated that, "a TBA was powerful and family members would listen to the advice given by her". Out of the 8 respondents, one said that she would leave the matter to the family members to make a decision so as to avoid being part of any consequences thereafter while the rest maintained that they would persuade family members to take appropriate action.

Do you have further connection with the woman after delivery?

Ng'anduna said that she followed up the woman after delivery to demonstrate to her how to bathe the newborn if it was the first baby. She encouraged the woman to observe personal hygiene in order to avoid any infection to herself and to the baby. Ng'anduna established the kind of food the woman was eating and gave advice where necessary concerning eating balanced diet. On the same discussion, Ng'akalungu, Ng'atuva, and Ng'andeveimwe said that they followed the women after delivery to ensure that the mother and the baby were feeding well. They examined the umbilical cord to make sure that it was properly tied and clean and if there were any signs of infection. They checked if the baby was kept warm and whether there was any sign of coughing or restlessness. On the contrary, Ng'anzula, Ng'amuli Ng'andike and Ng'akulikya did not maintain any contacts with their clients for various reasons. Ng'akulikya said that she did not have any further link with the women she assisted during delivery because she was afraid that further association with these women would be construed by the family members to imply that she was looking for alms from them. Ng'andike only enquired about the woman and the baby from her relatives when they encountered each other along the road. Ng'amuli said, "Unless the woman comes back to consult me, I have no further connection with her" while, Ng'anzula simply said that there was no further link with the woman after delivering the baby without making further comments.

What do pregnant women say about delivering babies in a health facility?

According to one of the respondents, most pregnant women preferred to deliver at home because they felt supported by their relatives and friends during childbirth. As she laments, "In contrast, pregnant women claimed that they were left alone in the labour ward, and the nurses told them to call them when they were ready to deliver. Sometimes these women called the nurses and the latter were nowhere to be found", said Ng'anduna, Ng'akalungu and Ng'akulikya shared similar sentiments about the nurses' negative attitude towards pregnant women with Ng'anduna. Ng'akalungu indicated that the relationship between the nurse and the woman in labour was not warm.

Ng'akalungu contributing on the same issue contended that, "Most women prefer to deliver at home because there is support from relatives and the traditional birth attendant. The support includes massaging, provision of warm drink during and after delivery". Contributing further to the above discussion, Ng'akulikya, Ng'anzula, Ng'andike and Ng'amuli said, women preferred to deliver at home where there was support and tender loving care from the TBA and other relatives.

What the 8 TBAs said regarding the attitude of nurses when women seek delivery in a health facility was likely to influence their choice of place of delivery. The Chi-square test analysis ($\chi 2=9.215$, df= 2, $p=0.010$) confirmed these sentiments by the respondents by indicating a strong correlation between negative attitude of medical staff and choice of place of delivery. Negative attitude of nurses towards pregnant women was also noted by Kumbani et al. (2013). These researchers conducted an investigation in Southern region of Malawi in the Chiradzulu district to explore why some women fail to give birth in health facilities. Their study revealed that one of the reasons why women did not deliver their babies in a health facility was the

unfriendly attitude of nurses towards them. Their respondents said they were shouted at and yet they expected to be treated with dignity.

Do you have any connection with nurses regarding your role as a TBA?

Five of the respondents; Ng'anduna, Ng'akalungu, Ng'akulikya, Ng'andeveimwe and Ng'anzula had contact with nurses. Ng'akulikya said that, when a pregnant woman faced any challenges during labour; she accompanied her to a health facility and handed over the case to the nurse. Many times she took pregnant women to the health facility to be assisted to know the position of the fetus which was very important because during delivery the head of the fetus should be presenting. Ng'akalungu and Ng'andeveimwe had similar views about their contact with the nurse. When they accompanied pregnant women to a health facility, the nurse taught them about their roles as traditional birth attendants and the need to refer pregnant women to a health facility where there was good care and trained medical staff. Ng'anduna made contacts with the nurse in case of a problem because the health facility was within reach while Ng'anzula was advised accordingly by the nurses that, if there was any problem regarding pregnant women she should accompany them to the health facility. Interestingly, the other 3 respondents; Ng'atuva, Ng'andike and Ng'amuli had no connection with nurses. Ng'amuli said that she did not have any connection with nurses even when she accompanied pregnant women to a health facility. She revealed that she did not identify herself as a TBA to the nurses because the Ministry Of Health had forbidden them from practicing their trade. Ng'andike had no connection with the nurses since she was not trained while Ng'atuva simply said she had no connection with nurses and did not want to talk about the issue.

Interview with pregnant women

Results

The research results indicated that, 126(93 percent) respondents out of 135 among those who attended ANC clinic had planned to deliver in a health facility. Nevertheless only 86(64 percent) out of 135 respondents delivered their babies in a health facility and the rest 49(36 percent) delivered at home assisted by TBAs. Out of the 30 respondents who did not attend ANC clinic, 18(60 percent) had indicated that they would deliver their babies at home. Six (20 percent) out of 30 respondents had indicated that they would deliver in a health facility. Surprisingly only 3(10 percent) respondents out of 30 delivered in a health facility and the rest 27(90 percent**)** delivered at home assisted by TBAs.

Confidence in the TBA

Seven (5 percent) respondents out of 135 who attended ANC clinic and 7(23 percent) out of 30 who did not attend ANC clinic delivered at home because of the confidence they had in TBAs after being assured by the latter that normal delivery was possible. Although, Mwikali had previously lost a baby during delivery at home, surprisingly, she still gave birth at home assisted by a TBA without any recourse to her previous loss under the patronage of a TBA. Nonetheless according to Mwikali, the death of her previous baby was God's design and it had nothing to do with the place of birth or the TBA conducting the delivery. However this time she delivered without any problem.

Nthoki seemed to have had real faith in TBAs, because she had been advised by the nurse to deliver in a health facility. Interestingly she chose to deliver at home when the TBA assured her of a safe delivery at home. Against all odds, she delivered safely. Kamene delivered also safely at home assisted by a TBA who she had confidence in. Ndini was contemplating delivering in a health facility until labour pains began. In her narration she said, "To avoid logistics of going to a health facility, when labour pains began I requested my husband to call a neighbor who was a good TBA. I was convinced that I was going to deliver normally without a problem since I never experienced any problems during my last delivery. As anticipated I delivered without problems".

Velesi on her part also narrated her experience during childbirth, she said:

> The membranes ruptured early and the amniotic fluid drained out and I started bleeding, but I was confident all would be well. The TBA and my mother in law massaged my abdomen with coconut oil and administered some herbs to induce labour pains. After sometime I experienced strong contractions and gave birth and the bleeding stopped.

Even though, 2 respondents among those who were assured by the TBAs of safe delivery at home, experienced childbirth challenges (excessive bleeding) as they attempted to give birth at home. For instance, Mbeneka was 36 years old with 2 children, one of which was born at home and the other one in a health facility without problems. According to the respondent, the TBA had assured her of a safe delivery at home. Unfortunately after giving birth she started bleeding excessively because the placenta was retained. The TBA managed to deliver it after sometime and the bleeding eventually stopped. Mbinya suffered from excessive bleeding after delivering because of retained placenta too. According to the respondent, the TBA and the mother in law put a tip of a rope in her mouth to enforce her to vomit so that the same force could exert pressure to expel the placenta. This happened and the placenta was expelled and the bleeding stopped.

Mumo aged 38, described her ordeal during childbirth in the following text:

> I have delivered all my 8 children at home successfully with encouragement from my husband. My husband always brought a TBA to conduct my deliveries. But I really wanted to deliver this baby in a health facility as I was advised by the nurse on account of my age. But I did not see the need of delivering in a health facility when the TBA assured me that the position of the baby in the uterus was okay since the head was presenting and progression of labour was fine. I began bleeding excessively immediately after birth. I was given a mixture of 'omo'(powder soap) and water and some concoction to drink in order to arrest the bleeding which worked. But I felt dizzy and weak after this. I was accompanied by my mother in law and my husband to Kitui County hospital where I was transfused blood because I was anaemic.

Mukulu aged 32, one among the 7 respondents had delivered 6 of her 8 children at home without complications. The 2 previous children delivered in a health facility were as a result of prolonged labour at home and the respondent was transferred to a health facility by the TBA. This respondent maintained that she was assured by the TBA that safe delivery was possible since the position of the baby was okay. She delivered at home without any problem.

Kakulu aged 38, also had delivered all her 7 children at home without any complications. Despite the fact that she had been advised by the nurse to deliver in a health facility, she finally delivered at home after the TBA observed that progression of labour was fine. Kutu aged 35 years had delivered her 4 children at home without complications with assurance from the TBA. This respondent delivered at home after being assured by the TBA that safe delivery was possible. Mutunge aged 28, single and was expecting her first baby, although she had attained secondary level of education, her mother convinced her to deliver at home under the care of the renowned village TBA who was her best friend. This respondent complied with her mother's plea and delivered at home. The remaining 2 respondents all gave birth safely at home after the assurance from the TBA that home delivery was possible.

Mbaluta who was 34 years old, had previously delivered one child at home. Though she had intended to deliver in a health facility when the TBA assured her of a normal delivery, she changed her mind and decided to deliver at home. Unfortunately after delivery, the baby did not cry immediately after birth. The TBA and the mother in law 'banged tins' hoping the noise produced would make the baby to cry. This method did not work. The last option was to splash cold water on the baby which worked. Kyale also chose to deliver at home simply because she believed that under the patronage of a TBA, she was assured of safe delivery.

Referral by TBA during childbirth

Seventeen (13 percent) out of 135 respondents who attended ANC clinic and 3(10 percent) respondents out of 30 among those who did not attend ANC clinic were transferred by the TBA in the process of childbirth. This action by the TBA clearly demonstrated the role she played by referring difficult cases to a health facility.

The remaining 131 respondents out of 165 that is, 135 who attended ANC clinic and 30 who did not attend ANC clinic were influenced by different factors in choosing place of delivery. For instance 57 were influenced by significant ones, 29 had the autonomy of choice, 22 had previous safe deliveries, 13 experienced previous complications during childbirth, 5 were aware of benefits of delivering in a health facility, 3 had precipitated labour while 2 delivered in a health facility because TBAs refused to conduct deliveries because of HIV/AIDs scourge.

Results from FGD

This discussion took place in two health facilities where 12 and 10 respondents were interviewed. The general view of these respondents was that, due to the role played by a TBA in influencing the choice of place of delivery, her position could not be overlooked.

5.0 Conclusion

Confidence in the TBA

According to the research findings 14(9 percent) out of 165 respondents delivered at home because of the confidence they had in TBAs after being assured by the latter that normal delivery was possible. Although, one of the respondents had previously lost a baby boy while delivering at home, surprisingly, she still sought services of a TBA claiming that death could happen anywhere because it was God's design. Another respondent defied the advice of the nurse against delivering at home. Besides the advice given by the nurse, the TBA had confirmed to her that the position of the baby in the uterus was okay and normal delivery was feasible. One respondent had full confidence in the TBA. When the membranes ruptured early and the amniotic fluid (the fluid that surrounds the fetus in the uterus to facilitate mobility) drained out and she started bleeding, the obvious thing to do was to organize for immediate transfer to a health facility because this was an emergency. Instead, she believed the TBA and her mother in law would manage the situation. The centrality of a TBA especially among the rural communities is associated with the highly valued social role they played in the communities (Owino and Legault 2013). They offered emotional support and continuity of care in comparison to the type of care that was made available at the health units. For instance, TBAs in Maasai usually go together with pregnant women to antenatal clinics, examine them at home, and refer them to health units for care if they identify a potential problem, otherwise during normal delivery TBAs stay with women giving birth through labour and up to five days post-partum (Magoma et al., 2010).

On the other hand, TBAs satisfy the expectations of the pregnant women which include; continual support and advice during pregnancy, delivery, and in the postpartum period, the provision of body massage throughout labour and delivery, and knowledge of a variety of delivery positions (Magoma et al., 2010). All these good tidings by the TBAs build a strong faith and confidence among the pregnant women who receive their services. Adding voice to this discussion on confidence on the TBAs, Rahmani and Brekke (2013) maintain that TBAs were popular because they were not expensive as they were paid in kind, they were tolerant and kind, and spent more quality time with pregnant women. Supporting the views of Rahmani and Brekke, Agus and Horiuchi (2012) pointed out that, some of the women they interviewed didn't have confidence in the new village trained midwives because they were often young, unmarried, and inexperienced. Respondents interviewed in this study had similar views as Agus and Horiuchi. For instance one of the respondents interviewed in this study said, "I am too old to be assisted by a young midwife in a health facility". While another said, "I feel safe to be assisted by a TBA". "So long as the TBA confirms that the position of the baby in the uterus was okay and normal delivery was possible, delivering at home where the environment was conducive was preferred to a health facility," one respondent asserted. "Hospitals are for referrals and it was okay to deliver at home," said one other respondent.

Agus and Horiuchi (2012) further maintained that, TBAs displayed overt interpersonal skill, special care, and respect for local customs which could not be exemplified by village midwives who were viewed as too young and inexperienced, whereas TBAs were more mature, patient and caring compared with the trained midwife. In Butajira district of Ethiopia, women preferred to deliver at home assisted by TBAs because

members of the family were allowed to be with her during labour and delivery which was consoling (Roro and Hassen 2014). These findings of Roro and Hassen were in line with what some of the respondents in this research observed. For instance one of the respondents said; I chose to deliver at home instead of delivering in a health facility because of the cordial relationship I have with the TBA and my family members".

This research revealed that a TBA had a profound role to play regarding childbirth. Apart from conducting deliveries, a TBA had multiple roles such as healing. For instance, this research indicated that a TBA was able to contain bleeding after delivery, administered herbs to hasten delivery process and managed to remove retained placenta. In the same way, a TBA had the privilege to decide whether a woman should deliver at home or in a health facility. According to this research, 20(12 percent) respondents out of 165, that is, 17 from those who attended ANC clinic and 3 from respondents who did not attend ANC clinic, were transferred to a health facility by the TBA during the process of childbirth after realizing that delivery was not possible at home.

Recommendations

Having ascertained the insightful role of the TBA, it would seem unwise to abandon the maternal services of a TBA since there was good evidence advanced in this research supporting their vital role among community members. Based on the confidence communities have in TBAs, there is therefore the need to train the latter in basic skills in order to give standardized maternal health care services. After training, TBAs could be allowed to conduct deliveries alongside nurses to learn new skills that they probably did not have. This collaboration could include follow up visits to support the TBAs in order to find out if there were any gaps that might require further input. During this time of follow up, the TBAs could also be encouraged to refer risky cases in good time to a health facility for further management.

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Physical Preconception of Primary Education Pupils

Slavica Brkić PhD
Faculty of Science and Education
University of Mostar
slavica.brkic@fpmoz.sum.ba
0038763489163

Ljiljanka Kvesić PhD
Faculty of Science and Education
University of Mostar
ljiljanka.kvesic@fpmoz.sum.ba
0038763355021

Marina Zubac
Faculty of Science and Education
University of Mostar
marina.zubac@fpmoz.sum.ba
0038763512132

Abstract

During their preschool age children discover natural phenomena in their environment. In their consciousness, they form the basic physical concepts based on experience. Their ideas can be right, but they can also be wrong because they take into consideration only what they see and thus, they come up with wrong ideas or misconceptions. At the very beginning of their primary education, teachers of class teaching directly witness their ideas related to basic physical concepts through various subjects: mathematics, natural sciences, art and physical education. Frequently, neither teachers nor their pupils consider these notions, thus their wrong ideas remain firmly rooted and present a barrier to the adoption of the correct physical ideas. Research of basic concepts related to motion, space and time was carried out as part of the workshop Class Teaching Course Open Days at the Faculty of Natural Sciences, Mathematics and Education of the University of Mostar. The sample consisted of pupils of primary education of Herzegovina-Neretva and West-Herzegovinian Cantons. It has shown that pupils have the correct ideas about many physical phenomena, but it has also shown the presence of intuitive ideas which are not in accordance with physical ideas and need to be corrected in time.

Keywords: physical ideas, intuitive ideas, research teaching, misconceptions, primary education.

1. Introduction

Physics is a science which has the greatest impact on the development of technology and the major problem is that it is the least attractive school subject for pupils. Comprehensive research conducted in German schools showed that pupils find physics, out of all school subjects, the most difficult and the least attractive subject despite the fact that the German educational system as a whole is deemed to be the best in the world. Negative attitude towards physics is the greatest (30%), with chemistry at the second place (28%), followed by mathematics (26%) (Paar, V. 2001). In order to achieve progress in physics teaching, the right physical preconceptions should be formed long before introducing physics as a school subject. The teaching has to be motivating and the required knowledge could be integrated in such teaching subsequently. In this process teachers have to be able to answer fundamental pupils' questions at all times: Why do I have to learn this? What's the purpose of it? In this sense, the physics teaching should establish direct relation to the problems of real life. The issues of real world will encourage pupils' interest and motivation and cause their curiosity and scholarly interest, as they would study something relevant to their lives. Thereat, it is desirable for lessons to be formed as stories or experiments which are easy to remember. From the very beginning of primary education, the science teaching should be conducted in natural surroundings, by monitoring and measuring variables, but in the simplified version of nature as well, in classroom or laboratory, where the conditions could be controlled and variables could be measured. In this way pupils develop critical attitudes and experience that the science makes us understand the world that surrounds us. Such teaching requires excellent teachers who should be selected out of the population of the best students. Teaching physics through other school subjects in primary education requires high level of intellectual engagement both on the part of teachers and pupils, which cannot be achieved with typical lecture-based teaching.

2. Interactive teaching

We are forced to make radical changes in physics teaching due to the character of contemporary physics and extraordinary quick development of science and technology. Successful education of physics at school is one of the most challenging issues facing modern education in the world. Teachers' responsibility is not to merely transfer knowledge but to develop a certain way of thinking, an understanding of basic concepts, as well as practical application of knowledge in problem situations.

"The anticipated knowledge cannot be poured in by a funnel; required attitudes cannot simply be glued on; experience belonging to others is not helpful. Experience is the result of an individual's activity. This activity must be real, realistic and life-concerning one, an activity directly contacting its surroundings. Teacher's ideas are just teacher's ideas, and pupils need to build their own ideas. No thought, no idea ... is possible to be transposed from one person to another as a conception ... An individual starts thinking when they directly deal with a problem, when they search for and find their own solution", (Dewey, J. 2009).

Standard oral tests, lecture or traditional tests cannot detect whether a pupil has really mastered knowledge that is in accordance with fundamental concepts of physics. Tests have shown that formal learning is not satisfactory and the solution is sought in the intellectual activation of pupils through interactive teaching. Types of questions and problems that students face are of essential importance in all forms of interactive

teaching. The issues that are important for understanding physical concepts are emphasized. Research has shown that students have firm ideas and explanations for some phenomena, which are significantly different from scientific explanations. These wrong ideas are called misconceptions (Helm, 1980) and it is important that teachers identify them promptly (Driver, 1985). The easiest way to detect and recognize them is through tests. Conceptual tests contain qualitative questions whose aim is to identify, recognize, and correct pupils' misconceptions. The results of the same test done by the pupils of fourth and fifth grade of primary education (ages 10 and 11) and the pupils of ninth grade of elementary school[1] (age 15) did not show a significant difference, which is a consequence of formal learning of physics. In order to develop scientific creativity and cope with new problem situations, it is necessary to set new educational goals to be pursued: pupils need to acquire the ability to deal with new problem tasks, to adopt previously unknown concepts, and to create new ones. These educational goals differ from the traditional ones in which the teachers were content with the reproduction of the material and the understanding of matter. Teaching and learning of physics requires a high level of pupils' intellectual involvement, and this is not achieved in typical lecture-based teaching. Contemporary education trends move the boundaries of education towards active learning. Active learning is a process of changes in the educational system that involves higher cognitive processes. The lowest educational goal is factual knowledge, which is not irrelevant as pupils need to know the basic concepts and definitions without which they cannot move forward. Higher educational goals include understanding, application of the learned, analysis, synthesis and evaluation. To achieve these goals, a greater interaction between pupils and teachers is needed; and it takes place in so-called interactive teaching. Interactive methods of work require much greater teacher's engagement and most of them would not readily accept it, and it is also difficult for pupils to get accustomed to the new method. Some of the pupils, once taught to get ready-made knowledge, are not interested in high quality learning. However, most pupils accept new methods as they feel as active participants of teaching where they can freely express their attitudes even though they might be wrong.

2.1 Physical Misconceptions

Apart from school and school education pupils also possess numerous and various kinds of knowledge. Experience has taught them that winters are colder than summers; that the Sun always rises on one side, and sets on the other side of the horizon; that objects thrown upwards always fall back to the ground. In the 1980s, it was revealed that pupils had certain ideas about many physical concepts and conceptual relations about physical phenomena that mostly did not correspond to the correct physical ideas (Driver, R. 1973). These wrong intuitive ideas are spontaneously developed by all pupils regardless of their background, upbringing or previous education, and they present a serious obstacle to learning physics. The research concerning intuitive ideas had no effect on the teaching until the work of R. Driver and L. Viennot in the 1980s (Driver, R. 1973, Viennot, L. 1979). Thereafter, there was a whole series of the investigations of wrong ideas which were called misconceptions. Traditional forms of teaching ignore the existence of misconceptions; they deal with the ready-made knowledge, trying to convey it to their pupils.
There are two types of misconceptions:

[1] Nine-year elementary education (five+four) is effective in Bosnia and Herzegovina

- Preconceptions
- Alternative ideas

Preconceptions. Preconceptions are wrong intuitive ideas that a pupil has before learning physics. Most pupils are not aware of their preconceptions and feel that their thinking is correct because it can easily be backed up with examples from everyday life. They came up as a need to explain the phenomena of the world in which they live without taking into account things that cannot be seen. Some of these ideas are very similar to the ideas we find in the history of physics, and in some periods they were accepted as valid. Their attraction lies in their simplicity and intuitive comprehensibility.

Alternative ideas. Alternative ideas are a mixture of intuitive ideas and formal physical learning. It is difficult to replace once created and accepted misconception with the correct physical idea.

Putting an emphasis on interactivity, today's teaching tends to confront misconceptions. Misconceptions are stubborn and it is important that teachers recognize them and try to eliminate them.

The easiest way of discovering pupils' misconceptions is through tests. If preconceptions are removed on time, then further physical laws, even harder physical laws will become easier to pupils, they will be adopted faster and, most importantly, pupils will understand them in the true sense of the word. The implementation of the test does not require any additional material resources, does not take much time, and the test results and analysis could contribute to the improvement of teaching. In order to be productive for teaching aims, the questions in the test should neither be trivial, nor too difficult; they should not be tricky questions, and it is good if the answers offered have some common typical reasoning errors. A new teaching method called peer instruction was introduced at introductory physics courses at Harvard University in 1991 (Mazur, E. 1997). In this method the classical lectures were replaced with short segments of lectures followed by a conceptual question related to the main topic of that part of the lecture. Students would give their answers and discuss them afterwards. The optimal range of correct answers was 35-70%, and then students would discuss the answers. If there were less than 35% of correct answers, it meant that students had failed to understand the given problem, and in such a case it was necessary to study the problem in more detail and explain it, and then to repeat the evaluation using another test. If there were more than 70% of correct answers, the questions were deemed as having been too easy (Mazur, E. 1997).

3. Research

Short tests present the easiest way of identifying pupils' misconceptions and preconceptions. In a very short time, teachers receive the follow-up information about the matter they are checking. The results of checking determine the course of future teaching; tests reveal which parts of the matter are the most difficult to pupils, in other words, which conceptions are not adopted correctly. Teachers should spend more time on such issues, as the matter once learned incorrectly is more difficult to correct subsequently. Pupils' misconceptions and preconceptions related to basic physical conceptions were examined at the Open Doors Day of the Classroom Teaching Studies in March in the academic year 2016/17 at the Faculty of Natural Sciences, Mathematics and Education of the University of Mostar, Bosnia and Herzegovina. Pupils learn about some fundamental conceptual physical conceptions within the curriculum of mathematics and

science, thus our tests partly related to already covered matter and partly to things not learned in class but familiar to pupils, and they had certain ideas about them which might be correct or wrong.

3.1 Test and Test Results Analysis

Pupils did closed type picture test. They had to find the right answer to the multiple choice questions. We will mention some multiple choice questions from the test and their results. The same test was given to the pupils of ninth grade of elementary school after they had gone through the first cycle of physics teaching, and the results were compared. Another sample group consisted of 120 pupils.

Test results show that pupils have no problems with the sense of quantity and numbers. The concept 'number sense' was used for the first time by Tobias Dantzing in 1954 in his book Number, the Language of Science. The author thinks that we were born with that sense and that a child in his early age can recognize the difference between two groups if we deduce or add one element to them. The questions related to quantity were the easiest for both groups of respondents, so they are not mentioned here.

3.1.1 Examples from the Test

1 - In Figure 1, there are three boys. Which of them can run the fastest?

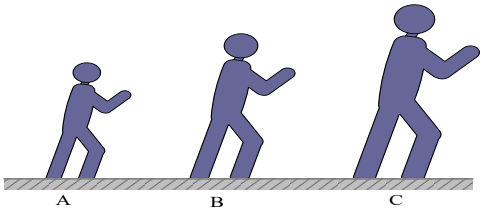

Figure 1.

Table 1. Distribution of answers in Test number 1

A(%)		B(%)		C(%)		X(%) Without answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
26,38	13,33	20,83	33,33	52,78	53,33	0	0

When asking this question, we thought that all the pupils will choose C answer. The tallest boy has the greatest strength and therefore he can run the fastest. Pupils' answers were based on their experience, and so a younger brother could be faster than the older one. We can see that the distribution of answers is equal for both groups of respondents although the pupils of the ninth grade learned about mechanical work and the force within the frame of physics curriculum (Šindler, G. and Valić, B. 1997).

2 - Three hills are shown in Figure 2. Which hill is the most difficult to climb to the top?

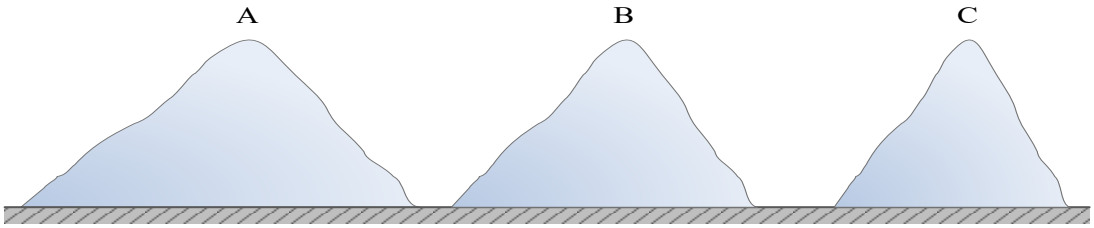

Figure 2.

Table 2. Distribution of answers in Test number 2

A(%)		B(%)		C(%) Correct answer		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
4,17	6,67	5,56	0	90,28	93,33	0	0

The answers to the second question confirm that the pupils' answers were based on their experience. Although pupils do not know the golden rule of mechanics, they know that the steeper a slope is, the harder it is to climb. There are more than 90% of correct answers, this meaning that the question was too easy for the pupils.

3 - There is a tree-lined road in Figure 3. Are all the trees of the same height?

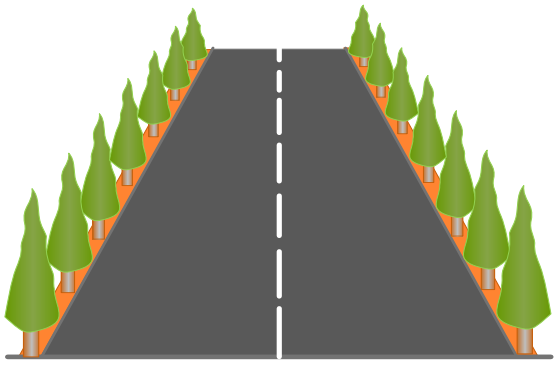

Figure 3.

Table 3. Distribution of answers in Test number 3

YES(%) Correct answer		NO(%)		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
36,11	60,00	63,89	33,33	0	6,67

4. There is a boy in front of the school in Figure 4. Which drawing is correct?

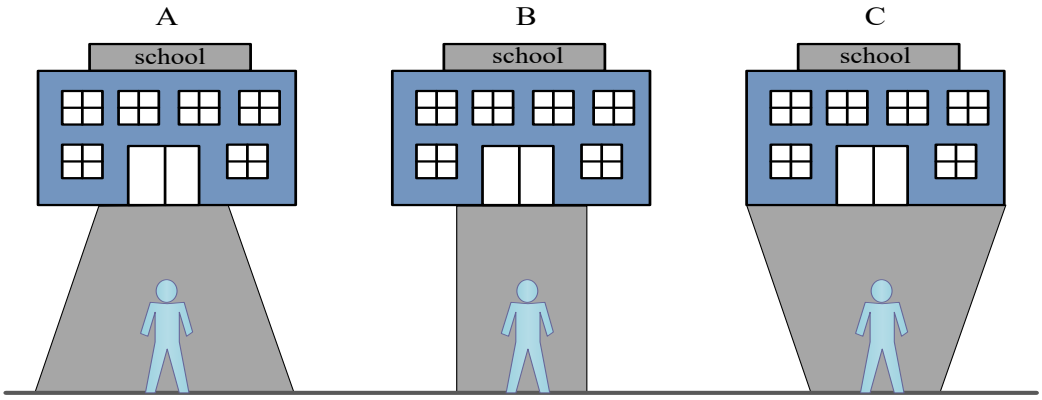

Figure 4.

Table 4. Distribution of answers in Test number 4

A(%) Correct answer		B(%)		C(%)		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
54,17	60,00	34,72	6,67	11,11	20,00	0	1,33

Both in Test number 3 and 4, the correct answer is A. There is a road in both pictures which seems to be narrower in the distance. Primary education pupils learn about space, movement and time through various school subjects. Within the school subject of Science and society in the first grade of primary school they learn distinction between closer and further, left and right, above and under (Markovac, J. and Zorić, V., 2015). If a photo of landscape is shown to children, all of them will know that the tree is closer than the house, the house is closer than the hill, and the hill is closer than the cloud, and the cloud is closer than the Sun. A teacher should discuss the photo of landscape to see how they explain the fact that the hill is further than the house. Whether their answer is: "Well, we know it's further" or their answer is: "Because hills are big and it seems to be small to us because it is far away"? The question is not in a familiar context, it confuses pupils, which is the consequence of formal adoption of knowledge, which is shown by their answers.

5 - There are three cubes made of different materials in Figure 5. Which cube is the heaviest?

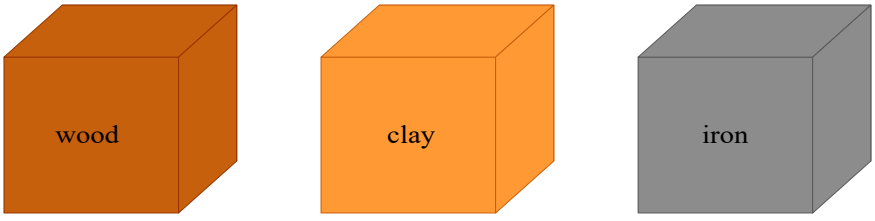

Figure 5.

Table 5. Distribution of answers in Test number 5

A(%)		B(%)		C(%) Correct answer		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
2,78	0	2,78	0	88,89	93,33	5,56	6,63

6 - In Figure 6, there are three bottles, each containing a liter of oil, water and alcohol, respectively. Do they weigh equally?

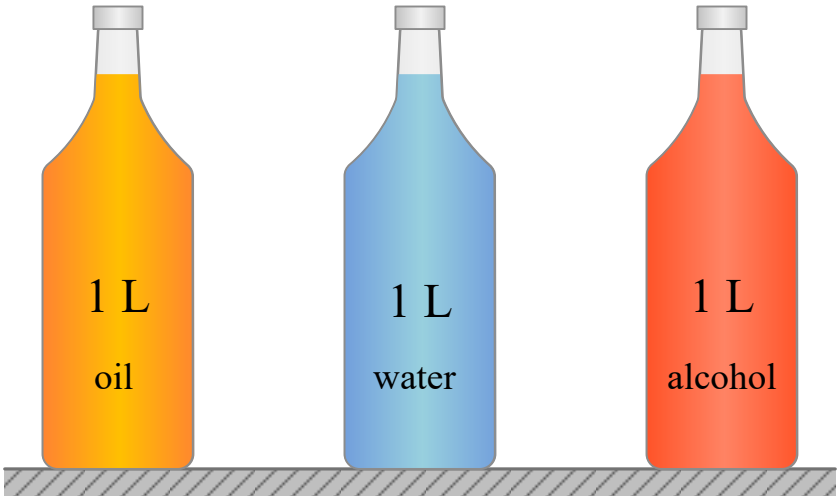

Figure 6.

Table 6. Distribution of answers in Test number 6

YES(%)		NO(%) Correct answer		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
43,05	46,67	31,94	33,33	25	20

Questions 5 and 6 are almost identical but for the pupils they seemed different. The confusing term is the 'liter'. This exceptionally allowed unit measure for volume is taught in mathematics in fourth grade of primary education (Markovac, J., Zorić, V.2015). All the children know that an iron cube of the same size is heavier than a wooden cube, but the question whether a liter of oil is heavier than a liter of water has been confusing pupils for generations.

7 - Figure 7 shows three containers of water, each having three holes. Which drawing is correct?

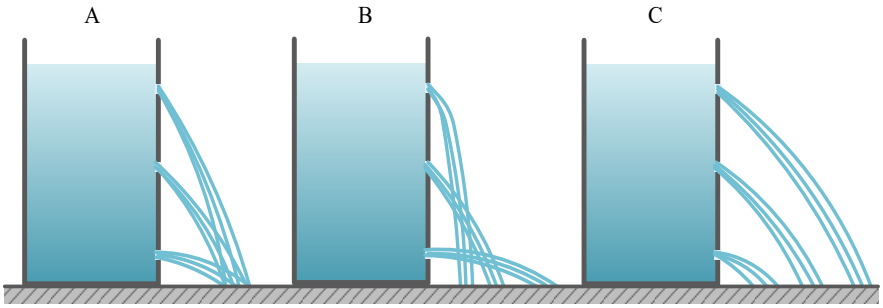

Figure 7.

Table 7. Distribution of answers in Test number 7

A(%)		B(%) Correct answer		C(%)		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
44,44	40,00	8,33	33,33	33,33	26,67	13,89	0

Preconceptions are connected to intuitive ideas and experience and it is not unusual that the seventh question has the least correct answers. The answers given by primary education pupils are incorrect but logical regarding the fact that they do not consider the things they do not feel or do not know, namely hydrostatic pressure. They have 8.33% of correct answers. Here we can see that ninth grade pupils also have more incorrect than correct answers although they learned about pressure in physics in eighth grade (Šindler, G. and Valić, B., 1997).

8 - There is a magnet in Figure 8. If it is moved closer to the table, it will attract

A. nails.

B. pieces of paper.

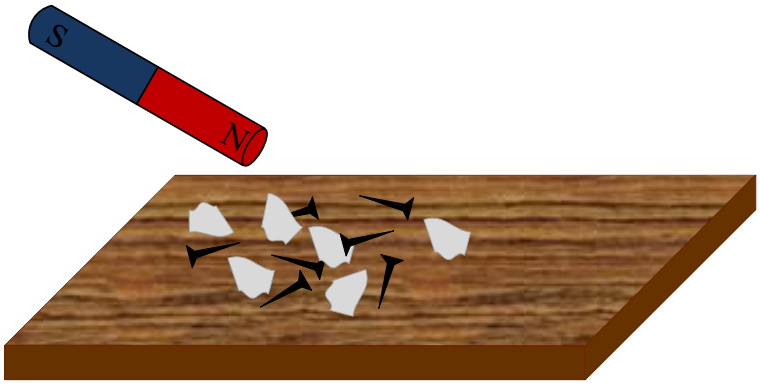

Figure 8.

Table 8. Distribution of answers in Test number 8

A(%) Correct answer		B(%)		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
98,61	53,33	0	6,67	1,39	40

The basic conceptions related to magnetism are learned within the school subject Science and society in fourth grade of elementary school (Jelić,T., Brkić, S., 2015). The eighth question was too easy for the pupils of fourth and fifth grade of elementary school whereas it was not the case with ninth grade pupils. We think that it is the result of traditional teaching and overloaded curriculum, which obviously led them to confuse electricity and magnetism. 40% of pupils failed to answer at all, which points to fear of wrong answer.

9 - Figure 9 shows an enlightened apple and its shadow. Which drawing is correct?

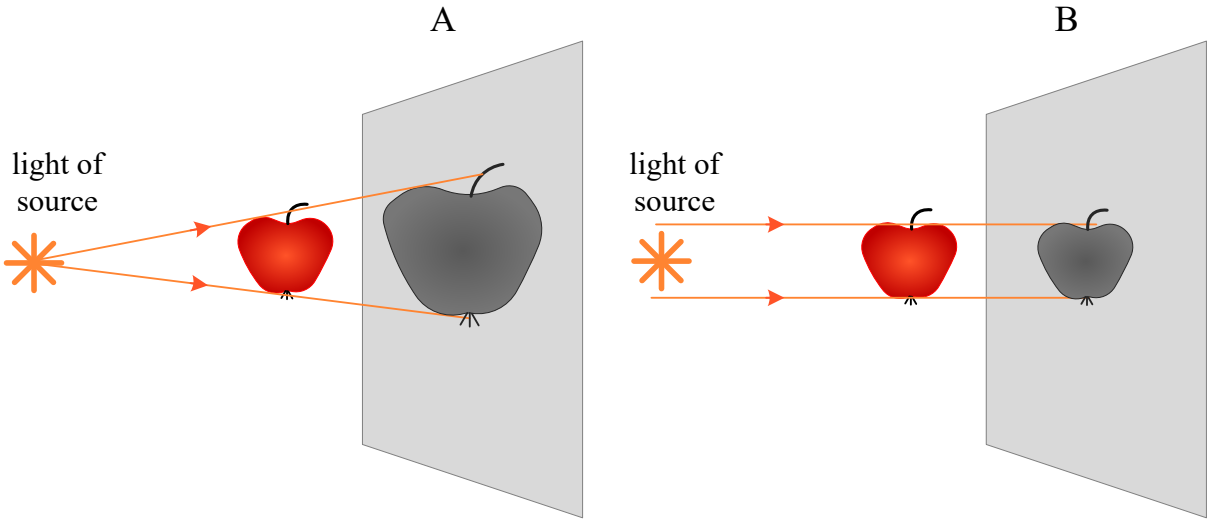

Figure 9.

Table 9. Distribution of answers in Test number 9

A(%) Correct answer		B(%)		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
56,94	33,33	43,06	33,33	0	33,33

Again, the primary education pupils have more correct answers to the ninth question although the ninth grade pupils learned basic laws of geometric optics. The first geometric optics law says that the light dispersion is linear, and the consequence of their badly adopted knowledge is the implication that it disperses in parallel lines.

10. Where is it easier to lift a stone?
    a. In the water.
    b. In the air.

Table 10. Distribution of answers in Test number 10

Water (%) Correct answer		Air (%)		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
43,06	53,33	55,56	33,33	1,39	13,33

11. Where is it easier to swim?
    a. In the pool.
    b. In the sea.

Table 11. Distribution of answers in Test number 11

A(%)		B(%) Correct answer		X(%) No answer	
4th and 5th grade	9th grade	4th and 5th grade	9th grade	4th and 5th grade	9th grade
16,67	13,33	80,56	60,00	2,78	26,67

Tests 10 and 11 are the same for those who are familiar with lift force. For those who are not, the answers are based on their experience. Primary education pupils have less correct answers to question 10 as they obviously never tried to lift a stone in water, but they know that it's easier to walk on a dry path than on a muddy one. Primary education pupils have more correct answers to question 11 than the elementary school

ninth class pupils who, burdened by teaching, fail to connect their knowledge with real life.

The results of our test showed that the answers of primary education pupils are based on experience, which does not always lead to the correct answer. Primary education pupils have more correct answers than the ninth grade pupils to the questions from the curriculum of the first cycle of physics, which is a consequence of traditional teaching. Traditional teaching tests factual knowledge as the lowest form of knowledge or pupils are required to complete a sentence. Such way of communication fails to encourage creative thinking and does not lead to high quality learning.

Educational research in physics has shown that interactive teaching of physics is much more efficient than lecture–based teaching, especially in development of conceptual understanding. It can also be noticed that another group had more unanswered questions, with fear of tests or wrong answer being a possible cause. Figure 10 shows the total distribution of the correct answers of primary education pupils and elementary education pupils.

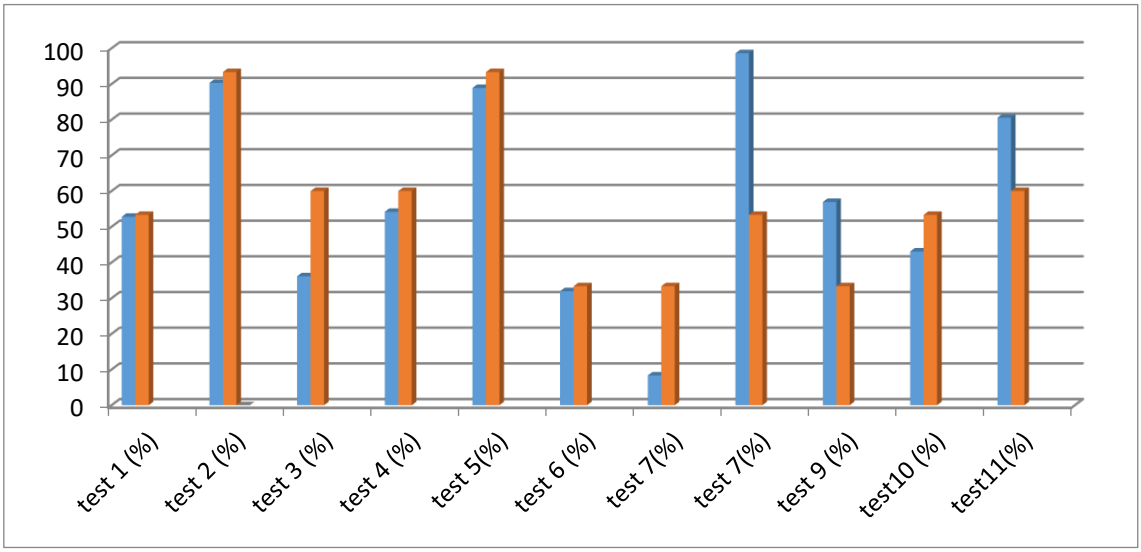

Figure 10. The distribution of the correct answers of primary education pupils (blue column-left) and elementary education pupils (red column-right).

4. Conclusion

Children discover basic physical phenomena in their earliest age. Through various school subjects, primary education teachers should find out whether their ideas are correct. Wrong ideas or misconceptions are difficult to identify during traditional way of working. Research and successful teaching practice showed that the research approach to teaching enables teachers in the best way to recognize, and pupils to adopt conceptual base which is essential for their further education. Conceptual tests present the fastest and easiest way for teachers to get feedback information on understanding physical concepts. Those tests turn the pupils' attention to important things, their knowledge is being corrected, changed and extended, and the result is long-lasting memory and ability to apply acquired knowledge to new situations. Good results present satisfaction to both pupils and teachers whereas bad results point to the need of changing work methods. Traditional teaching is deeply rooted work method and it may go through numerous radical

changes in order to reach better results; the solution is moving from traditional towards interactive.
The results of our test that was done by both primary education pupils and elementary education pupils are similar. It is notable that primary education pupils' knowledge is based on their experience, and they do not consider things they do not see. The same questions posed a dilemma for pupils notwithstanding the fact that the second group pupils worked on certain matters during physics teaching. It could be noticed that the elementary education pupils have less correct answers to the questions concerning the matter which is a part of their curriculum. The reason might lie in too extensive educational material and formal physical teaching. More frequent use of tests reduces the test fear; and more unanswered questions were given by the pupils of the second group which just points to the fear of failure.
Physics is nature, physics is in butterfly's flight, in birdsong, in rainbow and in mirage; physics is first learned in mathematics and science, which is important to be recognized by primary education teachers. Laws of physics are the base of our functioning. "There is no escape. There is physics all around you" [16].

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Exploring Traits of High-Performing, High-Poverty Schools

Aubrey Womack
Graduate Student
University of Mississippi
School of Education
University, MS 38677 USA
(863)444-0185
ajwomack@go.olemiss.edu

Jerilou J. Moore, Ph.D.
Professor
University of Mississippi
School of Education
University, MS 38677 USA
(662)915-7622
jjmoore@olemiss.edu

P. Renee Hill-Cunningham, Ed.D.
Assistant Professor
University of Mississippi
School of Education
University, Mississippi 38677 USA
(662)687-1942
reneec@olemiss.edu

Abstract

Over the past decade, there has been a significant increase in pressure placed on schools across the nation due to high-stakes accountability policies (Klar, 2014). It comes as no surprise that low performing schools feel constant pressure to raise the measured academic performance of all students. Rarely, do low-performing schools who have overcome challenging circumstances in order to increase academic achievement, get spotlighted. Educators need to identify the common factors attributed to increased student achievement. This can be achieved by examining the lessons and examples of high-performing schools so that all schools can succeed regardless of circumstances.

Keywords: High-Poverty, High Performing, school traits

Introduction

Over the past decade, there has been a significant increase in pressure placed on schools across the nation due to high-stakes accountability policies (Klar, 2014). It comes as no surprise that low performing schools feel constant pressure to raise the measured academic performance of all students. Rarely, do low-performing schools who have overcome challenging circumstances in order to increase academic achievement, get spotlighted. Educators need to identify the common factors attributed to increased student achievement. This can be achieved by examining the lessons and examples of high-performing schools so that all schools can succeed regardless of circumstances.

The purpose of this qualitative study is to discover common characteristics among high-performing, high-poverty. According to the National Center for Education Statistics, "High-poverty schools are defined as public schools where more than 75.0 percent of the students are eligible for FRPL, and mid-high poverty schools as those where 50.1 to 75.0 percent of the students are eligible for FRPL" (Nation Center for Education Statistics, 2017, n.p.). It is important to note that poverty can be experienced by anyone regardless of gender or race (Parrett and Budge, 2012).

Up until the new millennium, strategies focusing on improving low-performing schools with high populations of students living in poverty were little to nonexistent (Parrett and Budge, 2012). Improvements in technology in the 1990s made identifying schools who were at the low end of the spectrum much easier for educators to find (Parrett and Budge, 2012). Due to the increased availability of comparative data, researchers began to verify that there were in fact schools that were both high-poverty and high performing (Parrett and Budge, 2012). The Education Trust took an initial look at achievement data from high-poverty schools and they were able to verify that there were in fact schools where students of poverty were significantly outperforming schools containing more advantaged students (Parrett and Budge, 2012). This analysis by the Education Trust lead to numerous efforts geared towards learning about high-performing, high-poverty (HP/HP) schools and how other schools with high-poverty could improve.

According to the research of Parrett and Budge, there are hundreds of public schools across the United States who enroll large numbers of underachieving students who live in poverty and these schools have successfully reversed the long-standing traditions of low achievement and high dropout rates (Parrett and Budge, 2012). High-poverty schools do not become high performing by chance. Chenoweth and Theokas state that "These schools do, however, have something that helps explain their success: They all have excellent school leaders." (Chenoweth and Theokas, 2013, pg.57). Although this is not the only trait found among HP/HP schools, it is by far the most common trait that contributed to the overall success of the school by researchers. In fact, one study conducted by Leithwood, Louis, Anderson, and Wahlstrom (2004) concluded that up to one-quarter of all school effects on achievement can be contributed to leadership (Chenoweth and Theokas, 2013).

In exploring the characteristics of high performing, high-poverty schools, these questions need answering: What factors contribute to the effectiveness of high performing, high-poverty schools? Why are unique high-poverty schools high performing while so many others with similar demographics are not? What can be learned from high-performing, high-poverty schools that can help students who live in poverty, regardless of where they attend school?

There is a strong research base on high-performing, high-poverty schools and it is continuously growing due to high interest. It is important to identify the common characteristics seen among high performing, high-poverty schools by examining existing research. By exploring a multitude of studies and highlighting the major findings, schools gain insight into how to achieve at high levels regardless of their circumstances.

Research concluded that any school regardless of its' condition can become high performing (Parrett and Budge, 2012). Although researchers have been able to identify several elements that attribute to the increase in student achievement in high-poverty schools, there is no simple solution. There are several elements vital to school improvement, but it is important to note that it is complex and elements will play out differently in every school depending on the specific context of the individual school.

The study by Parrett and Budge identified and visited seven diverse HP/HP schools who were recognized by the Education Trust, the U.S. Department of Education, and their individual state departments of education for having significant gap-closing improvements (Parrett and Budge, 2012). The researchers conducted both formal and informal interviews with leaders (administrators, teachers, school trustees, and other personnel) in order to hear what they believed contributed to schools; successes (Parrett and Budge, 2012).

This study along with previous research in the field, allowed researchers to develop a framework of elements that contribute to the success of HP/HP (Parrett and Budge, 2012). Parrett and Budge (2012) claim that leadership is at the heart of improvement of such schools, and "significant student gains will not be sustained without effective leaders who serve as a catalyst for the specific actions that in turn drive the success of these schools" (pg.33). Effective school leaders in HP/HP schools are not only great leaders, but most importantly, they gained an understanding of the unique needs of their students who live in poverty (Parrett and Budge, 2012). Similarly, Karin Chenoweth (2009) states that, "Schools that successfully teach students of poverty and students of color do not begin with the assumption that there are things they do not have to explain." (pg. 40). Leaders in high-performing, high-poverty schools note that it is not about fixing the students, it is about fixing the school so that all students feel that they belong and that they can succeed (Parrett and Budge, 2012).

In order to understand what an exceptional leader looks like specifically in high-performing, high-poverty schools, Chenoweth and Theokas (2013) examined the work of four principals and they were able to discover four qualities that successful leaders tend to share. The qualities encompass the common characteristics found in the literature used in the classroom.

The first quality found in successful school leaders is that "Their beliefs about student potential drive their work." (Chenoweth and Theokas, 2013, pg. 57). One of the principals in a low-performing schools said, "I learned through my teaching experiences that my students were capable of learning just about anything I was capable of teaching." (Chenoweth and Theokas, 2013, pg. 57). When the principal left five years later it was one of the highest performing schools in the state (Chenoweth and Theokas, 2013). The leaders in successful HP/HP schools do not lower standards, water down the curriculum, or slow down the instruction. (Parrett and Budge, 2012) Instead, these schools strive for excellence, equality, and equity. A major study exploring HP/HP schools in California states that, "Most principals said that the

standards were attainable for their students and that if high expectations are set, students rise to those expectations" (Izumi, 2002, pg. 48).

The second common quality was that principals "put instruction at the center of their managerial duties" (Chenoweth and Theokas, 2013, pg. 58). These principals ensured that school schedules maximized both instructional time for students as well as collaboration time for teachers. The principals in the study made time to attend these meeting regularly so that teachers saw the importance of collaborating (Chenoweth and Theokas, 2013). When there is not a sufficient amount of collaboration among teachers and school leaders students rely on the knowledge of their individual teachers and that can potentially become problematic, particularly in regards to students of poverty. The education of students living in poverty is often left up to the school because parents of these children often do not have the knowledge or resources to help their children themselves (Chenoweth, 2009).

Effective leaders commonly "focus on building the capacity of all adults in the building" in HP/HP schools (Chenoweth and Theokas, 2013, pg. 58). It is important for principals to recognize that teachers are responsible for their students' success in the classroom, but at the same time understand that not all teachers are fully, prepared (Chenoweth and Theokas, 2013). Chenoweth (2009) states that, "No teacher can be an expert in all aspects of the curriculum, all the possible ways to teach it, and every child who sits in his or her class" (pg. 42). When faculty and staff work as a team, all of the energy and expertise is concentrated with a much larger effect, than working in isolation (Chenoweth, 2009). There is a need for frequent testing to discover the strengths and weaknesses of both students and teachers in order to improve (Izumi, 2002). Having systems put in place by principals in order to develop teachers' knowledge and their ability to problem solve leads to success in the classroom (Chenoweth and Theokas, 2013).

The last common quality found among successful leaders in HP/HP schools is that "They monitor and evaluate what leads to success and what can be learned from failure." (Chenoweth and Theokas, 2013, pg. 58). When principals use evidence to guide decisions and know whether something is working or not then, that is when progress is made. Helping teachers use evidence-based methods in their classrooms is crucial to the success of the students. A major part of being a successful leader is looking for solutions to problems and ways to, continually, improve (Chenoweth and Theokas, 2013). When there is a school-wide commitment to continuous improvement, much progress can be made (Hayes, 2009).

The Vermont State Department of Education conducted a study in which they identified three of their highest-performing, high-poverty schools and explored effective practices. The study was able to identify eight specific characteristics of HP/HP schools. At the top of the list is high expectations. Hays says in successful HP/HP schools observed, "Every child, regardless of socioeconomic background, was held to high expectations and poverty was never used as an excuse for low performance." (Hayes, 2009, pg. 15). While communicating and holding students to high expectations is primarily the job of the teacher in the classroom, in order for it to be highly effective everyone in the school must hold the students to a high standard from the teacher to the librarian (Hayes, 2009). The idea of all students being capable of learning and growing is something that has to be embedded within the school culture (Chenoweth, 2015).

Unfortunately, many teachers who are faced with students who achieve at low levels feel a sense of powerlessness due to the challenges resulting from poverty (Chenoweth, 2009). While teachers of

HP/HP schools are not naive about the challenges that are presented by poverty, they refuse to blame these challenges on poor performance (Hayes, 2009). Instead, these teachers and staff continue to hold standards high and keep pushing students to be the best that they can be (Hayes, 2009). In rural Delaware, poverty rates are high but so are the expectations (Chenoweth, 2015). The superintendent claims that monitoring students' progress is key (Chenoweth, 2015). She looks at teacher evaluations to ensure that principals are holding teachers to a high standard in which all students will succeed (Chenoweth, 2015). Principals in the district are expected to review samples of student work to be sure that teachers are holding students to a high standard (Chenoweth, 2015).

Sometimes, "success is measured by how much attitudes and perceptions shift from negative to positive," according to Rutherford, Hilmer, and Parker, (2011, pg. 42). Research commonly found that many school leaders accredited their school's overall success to the positive, supportive climate of the school. Many researchers noticed a difference in the school climate as well, "The successful high-poverty and high-minority schools I've visited have very different atmospheres." (Chenoweth, 2009, pg. 42). Hays (2009) found that effective HP/HP schools "create a supportive climate that makes all students, as well as adults, feel valued and safe." (pg. 47"). A safe and supportive school climate is particularly important for students who live in poverty because they do not always feel secure outside school (Hayes, 2009). When students feel safe they are able to relax and focus on learning (Hayes, 2009).

Relationships play a large role in creating a safe and supportive school climate in high-performing, high-poverty schools. Students of poverty may not have had a consistent relationship with an adult or someone who believed in them before they came to school (Hayes, 2009). One of the local school board members commented, "With the poverty level here there's also a level of low self-esteem. But, when students walk into this building, one of the tasks that is met head-on is building self-esteem and I think that's one of the reasons that we are successful. No child (feels) that they are less than they should be and the hope is that they build self-esteem and look forward to bigger and better things in the future" (Hayes, 2009, pg.48).

While leadership is at the heart of improvement, it is important to note that it is second to classroom instruction (Leithwood, Louis, Anderson, and Wahlstrom, 2004). Unfortunately, oftentimes, quality teachers leave high-poverty schools because of unsatisfactory working conditions (Duncan and Murnane, 2014). These schools often lack the components needed for success: strong leadership, a culture of collaboration and shared responsibility, and resources (Johnson, Kraft, & Papay, 2012). While strong leadership cannot guarantee that high-poverty schools will succeed in creating the conditions required to retain strong teachers, they are a necessary element (Duncan and Murnane, 2014). Effective school leaders in HP/HP schools are able to help "ordinary teachers become excellent and create schools where excellent teachers want to work" (Chenoweth and Theokas, 2013, pg. 59)

Why are certain high-poverty schools high performing while so many others with similar demographics are not? Chenoweth (2009) who has conducted several studies on high-performing, high-poverty schools and says "I've come to the conclusion that they succeed where other schools fail because they ruthlessly organize themselves around one thing: helping students learn a great deal." (pg. 39). When the main goal of a school centers on helping students learn, it seems that everything else falls into place.

There are many lessons that can be learned from high performing, high-poverty schools. The research suggests that if all schools learned from HP/HP schools there would be a significant increase in achievement. Some suspect that many schools are coasting on the advantages of their students rather than through instruction (Parrett and Budge, 2012). Based on the findings of research, there are three common characteristics seen among high-performing, high poverty schools; exceptional leadership, high expectations, and a supportive school climate (see figure 1). Although there are a number of characteristics seen in high-performing, high-poverty schools the research shows that these three specific characteristics were the most commonly found and that they were the most effective in the schools observed. Research concludes that any school has the potential to become high performing, regardless of circumstances. Figure 2 provides websites with suggestions for helping students in high poverty schools.

Figure 1: Traits of Successful High-Poverty Schools

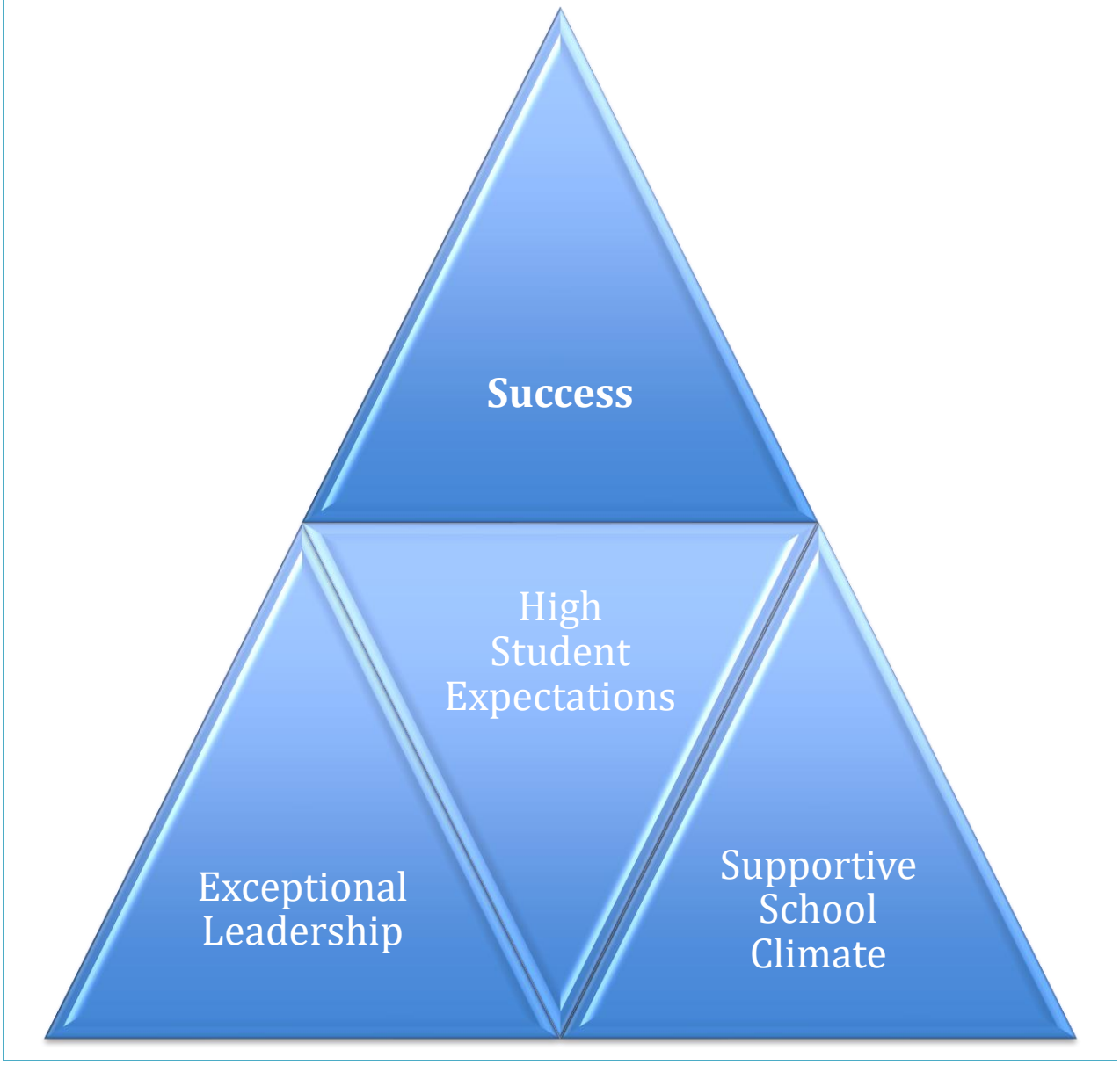

Figure 2: Suggestions for High-Poverty Schools

Websites:

https://www.nsba.org/newsroom/high-poverty-schools-can-be-high-achieving-0

https://www.washingtonpost.com/news/answer-sheet/wp/2017/12/21/yes-there-are-high-poverty-public-schools-that-operate-at-a-high-level-heres-how-they-succeed/?noredirect=on&utm_term=.ba98c5dd48a5

https://www.edutopia.org/blogs/tag/culturally-responsive-teaching

http://educationpost.org/5-tips-for-teaching-ap-in-a-high-poverty-urban-school/

http://hechingerreport.org/four-tips-successful-elementary-school/

http://www.ascd.org/ascd-express/vol6/603-sanders.aspx

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Improving Pupils' Genuine Love for Reading and Critical Thinking Using the Strategies of the Four-Pronged Approach

Antonieta S. Palasan, MAEd, MA, Ph.D.
Mindanao State University-Integrated Laboratory School
Marawi City, Philippines

Abstract

This study aims at improving the language skills of pupils, particularly their Genuine Love for Reading (GLR) and Critical Thinking Skills (CTS), which are two components of the Four-Pronged Approach to English language teaching. The other two components are Grammar and Oral Language Development (GOLD) and Transfer Stage (TS) but they were not included in this study. The researcher conducted the study using the pre-test—post-test quasi-experimental research design in which fifth grade pupils were divided into two groups: the control group exposed to the regular teaching approach and the experimental group exposed to the instructional strategies of the four-pronged approach for 78 sessions. Prior to the conduct of the interventions, a pre-test was administered to determine the pupils' level of GLR and CT. The researcher also prepared lessons plans that followed the instructional plan of the four-pronged approach, which were used during the 78 sessions. Results revealed that the experimental group's Genuine Love for Reading (GLR) and Critical Thinking Skills (CTS) improved significantly as compared to those in the control group. The findings suggest that the strategies of the Four-Pronged Approach help enhance in English language abilities of pupils. Relevant recommendations are forwarded in light of the outcomes of the study.

Keywords: English as a Second Language, Language Skills, Genuine Love for Reading, Critical Thinking, Four-Pronged Approach

1. Introduction

Reading is one of the most important skills a person can acquire. It is a process of getting meaning from the printed page and interpreting symbols drawn from the image, idea, passion or experience of the author. Through reading, a person can get information concerning problems or issues that affect human life. Thus, reading is the primary key to all knowledge. It offers an effective access to information, ideals, aspirations and happenings of both past and the present. By it, we can broaden our horizons from home, country and the world. It is reading that brings us closer to our surroundings, that changes our outlook, broadens our interests, gives a deeper insight of things and promotes richer and stable personality.

Obviously, one cause of dissatisfaction in school is reading failures on the part of the students. The inability of the students to read often results in their dropping out of school, hence, depriving them of the enjoyment of being fully human. A student who is not given the opportunity to read cannot function in a proper way; he cannot live a full human and social life enjoyed by those who are exposed to the world of the printed page.

Reading is considered a basic subject in the school curricula. It is a tool for learning in the other areas of the school curriculum. A student's success in all academic subjects is in a way related to effective reading. However, perennial problems of teachers in elementary schools in failures and dropouts and low achievement are often caused by reading deficiency. A good number of children today still have hardly developed their reading skills, much less their love for reading. Elementary school teachers are experiencing difficulties and problems in educating the pupils particularly in English subject due to lack of pupils' interest in reading.

There is really no approach to the teaching of reading that works absolutely for all children. Research shows that reading instruction must be balanced. Thus, we should use both phonics and whole language and teach both skills and literature, and when we find it difficult to choose which one to use or teach, the best thing to do this is think of the students. The Four-Pronged Approach is a literature-based approach to reading and language learning. This holistic approach provides adequate opportunity for developing reading and other language skills, as all the four components are implemented: Genuine Love for Reading (GLR), Critical Thinking (CT), Mastery of the Structures of the English/Filipino Language (MSE/FL) or Grammar and Oral Language Development (GOLD), and Transfer Stage (TS).

Genuine Love for Reading (GLR) aims to develop a lifetime love, habit and enjoyment of reading. It is strongly and rightly anchored on storybooks because children love stories. Corollary to the development of a love for reading is the development of the thinking mind. Age is not a barrier on the ability to think critically. There is no reason to delay emphasis on developing Critical Thinking (CT) until later grades or years in school. This aims to develop the habit of reflecting on what is read and exercising decision making, making judgments, and valuing. Mastery of the Structures of the English /Filipino Language (MSE/FL) or Grammar and Oral Language Development (GOLD) aims to develop competence in oral language, understanding, and correct use of syntax. Transfer Stage (TS) aims to develop phonemic awareness, decoding and encoding skills.

The researcher conducted this research to help English language teachers improve and to enhance the reading ability of the learners by improving their Genuine Love for Reading (GLR) and Critical Thinking (CT) using the instructional strategies of the four-pronged approach. The researcher believes that in aiming for better and effective teaching, teachers must determine which teaching approach works better for learners.

2. Literature Review

There are several overlapping and sometimes conflicting theories on reading acquisition. Depending on the theory of instruction adopted by the teacher or a school, the impact of a theoretical orientation is tremendous on students, especially for second language students. Durkin (1985) addressed this issue when she discussed the various theories of language acquisition in her book, *Language Issues: Reading for Teachers*. Durkin stated that the model applied to each child to speak a primary or secondary language has an impact on the type of reading and writing instruction provided in schools. Regardless of the model adopted, reading theorists agree that extensive reading is essential for the development of reading comprehension in a pupil (Cummins, 2005).

In children's development, oral language, reading and writing are significantly and dynamically concurrent, that is, they build upon one another. Reading involves the use of language. Thus, the acquisition of oral language and reading might share similarities since language learning is integral to learning to read. Writing involves the integration of knowledge of reading with knowledge of writing. Therefore, language aids speaking, reading and writing: reading aids speaking and writing, writing aids speaking and writing, a whole language approach.

Meanwhile, Halliday (1975) described how language helps children to learn to ascertain meaning from the world around them. While Chomsky (1972) found that children who were introduced to literature at an early age tended to develop sophisticated language structures. Therefore, promoting early literacy must be significantly holistic, which utilizes functional experiences that include the use of oral language, listening, writing and reading in a continuum.

Further, Hansen (1969) reported that a literacy-rich environment correlates most highly with children's early reading. Durken (1966), Holdaway (1979), and Teale (1984) described home environments in which the ability and the desire to read develop quite naturally especially in their homes, which serve as a rich environment. Goodman (1984) asserted that literacy-rich environments can make learning to read as natural as language acquisition.

Research findings indicate that the children who experience difficulties in learning to read are likely to experience a negative cycle of low self-esteem, reduced motivation and less persistence at academic tasks, leading to further failure experiences (e.g., Carr, Borkowski, and Maxwell, 1991; Fulk and Montgomery-Grymes, 1994; Gurney, 1988; Stanovick, 1986), come as no surprise to most educators.

Although there may be many reasons why children have difficulty learning to read, research indicates that the vast majority of poor readers share a common source from their reading problem, which is failure to develop accurate and efficient (i.e., automatic) word recognition skills (Stanovick, 1996). Moreover, a large and growing body of research evidence suggests phonemic awareness of the phonemes of sounds within speech to be the root cause of the problem for most poor readers (Munro, 1992; Stanovich, 1986). Phonemic awareness refers to the initial acquisition of spelling-to-sound correspondence skills necessary for efficient reading in an alphabetic language (Munro & Munro, 1993; Spear-Swerling & Sternberg, 1994). Longitudinal studies suggest that children who fail to develop efficient word recognition skills in first

grade, display ever increasing deficits in both accuracy and speed of word recognition (e.g., Juel, 1988; Snowling, Goulandris, & Defty, 1996). As they advance through the primary grades and into high school, particular problems with decoding long, polysyllabic words may be exhibited. In addition, they are likely to display an inability to generalize the ruled for pronouncing long words, and a tendency to rely on only one strategy such as "sound-out" by letter-sound correspondence or to make guesses based on only a few letters. Their lack of automatic word identification skills may also lead to a greater but far less efficient reliance on context cues than that of good readers (Stanovich, 1992).

3. Methods

This study employed the quasi-experimental method, particularly the pre-test-post-test design, which divided the pupils into two groups, the experimental and the control group. The experimental group was exposed to the instructional strategies adopted from the Four-Pronged Approach, while the control group continued to attend regular classes. The experimentation commenced with a pre-test given to the two groups before the application of the intervention. Subsequently, after the conduct of the experimentation, a post-test was done using the same test but with disarranged items and options.

The Mindanao State University-Integrated Laboratory School, where this study was conducted, has elementary and secondary students. Forty-four (44) fifth grade pupils were the participants of the study. The results of the pre-test as well as the pupils' age and sex were used in grouping them into experimental group and control group. The duration of the experiment lasted for three months, which totalled to seventy-eight (78) sessions from Monday to Friday with one hour daily session. The schedule of the class was 7:30-8:30 in the morning. During the experiment, the instructional plan adopting the Four- Pronged Approach was used in different activities such as writing, group activity, Think-Pair-Share using the Survey, Question, Read, Recite and Review (SQ3R) in promoting their reading and language skills.

There are four sub-skills in the Four-Pronged Approach, to wit: Genuine Love for Reading (GLR), Critical Thinking (CT), Grammar and Oral Language Development (GOLD), and Transfer Stage (TS). However, only Genuine Love for Reading and Critical Thinking were focused in this study.

4. Results and Discussion

Table 1. Pre-test Score Profile of the Participants in the Experimental Group

Sub-skills	No. of Items	H.M.	A.M.	SD	Description	z-Test	Interpretation
GLR	8	6	4	2.09	Below Average	4.49	Significant
CT	6	4.5	2.59	1.40	Below Average	5.00	Significant

H.M.= Hypothetical Mean Criterion Set: 75% Level of Significance: 0.01

A.M.= Actual Mean SD= Standard Deviation Critical Value: 1.96

Table 1 shows the pre-test score of the experimental group. As indicated, the participants obtained a score profile of Below Average in both sub-skills since they had greater H.M. than the A.M. Moreover, the z-

test values were greater than the critical value 1.96. Therefore, there were significant differences between the hypothetical mean and actual mean of the pre-test score profile of the participants in their Genuine Love for Reading (GLR) and Critical Thinking (CT).

Genuine Love for Reading (GLR) aims to trigger the schemata of the learners and prepares the learners for the actual reading of the text. Here the teacher establishes the proper mind set of the students. The result of the study points out that the participants were not focused and not motivated to appreciate reading.

Critical and creative thinking skills of emergent learners must be fully developed. That is to say, that the participants, as emergent learners, though young, were not yet skilled in being very inquisitive of many things around them, familiar and unfamiliar. They were not yet able to come up with the expected skill of being creative in finding answers to their questions and lacked the skill to hypothesize, experiment, and feed their curiosity.

Table 2. Pre-test Score Profile of the Participants in the Control Group

Sub-skills	No. of Items	H.M.	A.M.	SD	Description	z-Test	Interpretation
GLR	8	6	3.91	1.79	Below Average	5.50	Significant
CT	6	4.5	3.00	1.51	Below Average	4.69	Significant

H.M.= Hypothetical Mean Criterion Set: 75% Level of Significance: 0.01

A.M.= Actual Mean SD=Standard Deviation Critical Value: 1.96

As can be gleaned in Table 2, pupils were able to get Below Average in Genuine Love for Reading (GLR) and Critical Thinking. Hypothesis testing resulted in significant differences between the hypothetical means and actual means in the aforementioned sub-skills. The result signifies that the participants did not demonstrate expected mastery in Genuine Love for Reading (GLR) and Critical Thinking (CT).

Table 3. Post-test Score Profile of the Participants in the Experimental Group

Sub-skills	No. of Items	H.M.	A.M.	SD	Description	z-Test	Interpretation
GLR	8	6	7.45	0.77	Below Average	-9.01	Not Significant
CT	6	4.5	5.64	0.64	Below Average	-8.14	Not Significant

H.M.= Hypothetical Mean Criterion Set: 75% Level of Significance: 0.01

A.M. Actual Mean SD=Standard Deviation Critical Value: 1.96

Table 3 reveals the post-test score of the experimental group. As disclosed, pupils attained Above Average score in all sub-skills. When computed for significance, the Z-test values were less than the critical value. Thus, there were no significant differences between the hypothetical means and the actual means of the post-test scores of the participants in the experimental group. This finding implies that the participants were able to increase their attention span, developed their listening comprehension, developed oral language, vocabulary, and concepts; developed basic comprehension, critical and creative reading and possessed phonological or phonemic awareness, book and print knowledge and perceptual skills such as auditory and visual perception and discriminations.

Table 4. Post-test Score Profile of the Participants in the Control Group

Sub-skills	No. of Items	H.M.	A.M.	SD	Description	z-Test	Interpretation
GLR	8	6	4.86	1.66	Below Average	3.26	Significant
CT	6	4.5	3.82	1.70	Below Average	1.89	Not Significant

H.M.= Hypothetical Mean Criterion Set: 75% Level of Significance: 0.01

A.M. Actual Mean SD=Standard Deviation Critical Value: 1.96

It is found in this study that the post-test score profile of the participants in the Control Group was Below Average in the sub-skills Genuine Love for Reading (GLR) and Critical Thinking (CT). This finding is so because, as can be viewed in Table 4, the sub-skill, Genuine Love for Reading (GLR), yielded a hypothetical mean of 6, which was greater than the actual mean of 4.86. The Critical and Creative Thinking (CT) skills of the participants also were described as Below Average since the hypothetical mean of 4.5 was greater than the actual mean of 3.82.

Hypothesis testing proved that there was a significant difference between the hypothetical mean and the actual mean in the post-test score profile of the participants in Genuine Love for Reading (GLR). However, in all the other sub-skills, Z-test values yielded were less than the critical value of 1.96, denoting no significant difference between the hypothetical mean and actual mean in the post-test score profile of the participants in the Control group.

The data point out that the participants did not come up with the expected adequate skills in Genuine Love for Reading (GLR) and Critical Thinking (CT). This implies that for them, there is really a need to provide varied and more effective instruction in learning English.

Table 5. Mean Gain of the Participants from the Pre-test to the Post-test in the Experimental Group

Sub-skills	Mean		Mean Gain	SD	t-Test	Interpretation
	Pre-test	Post-test				
GLR	4.00	7.45	3.41	4.23	3.79	Significant
CT	2.59	5.64	3.05	3.50	4.07	Significant

Level of Significance: 0.01 Critical Value: 2.831

Table 5 presents the mean gain of the participants from the pre-test to the post-test in the Experimental Group. A mean gain of 3.41 was obtained from the pre-test to the post-test score in the sub-skill Genuine Love for Reading (GLR); a mean gain of 3.05 obtained in Critical Thinking (CT); 2.36 was the mean gain in Grammar and Oral Language Development (GOLD). When tested at 0.01 level of significance, t-test values yielded in the sub-skills Genuine Love for Reading (GLR) and Critical Thinking (CT) were greater than the critical value of 1.96. Therefore, the null hypothesis was rejected, denoting that there were significant mean gains in the participants' Genuine Love for Reading (GLR) and Critical Thinking (CT) post-test performance after they were subjected to the Four-Pronged Approach. It is inferred that there was

an improvement from the pre-test to the post- test score profile of the participants in the Experimental Group. Learning took place since the participants manifested an Above Average mastery in the above-mentioned sub-skills. Therefore, the Four-Pronged Approach was effective in the Genuine Love for Reading (GLR) and Critical Thinking (CT) skills of the participants.

The Four-Pronged Approach is practically based on the principles of Content-Based Instruction (CBI) which covers reading in relation to other content areas; thematic approach, whereby different areas of the curriculum are related together and integrated to a central theme; and construction, which argues that humans construct meaning from current knowledge structures. In the Four-Pronged Approach, the teacher acts as the facilitator of learning (Marquez et al, 2009).

The sub-skill of Genuine Love for Reading (GLR) should be developed as it is the start of the "learning reading" process. It covers the pre-reading and during reading stage and is the vocabulary building part.

Another sub-skill of the respondents that was enhanced by the Four-Pronged Approach was critical and creative thinking or CT. Critical and creative children are identified as theory-builders and hypothesis-testers who require challenging experiences that can be achieved with sensitive adult guidance.

Finally, a significant mean gain was achieved using the Four-Pronged Approach in the Transfer Stage (TS) of the participants in the Experimental Group. According to Marquez et al (2009), the transfer stage is an indicator of children's learning and literacy as they apply their knowledge and skills in varied literacy setting. It may be achieved by teacher's planning of specific literacy experiences and by providing meaningful activities like story reading, story- telling, shared reading, retelling, phonemic awareness, sight-word vocabulary, games and toys, socio-dramatic play, free-play and guided play.

It must also be noted that the participants' skill in Grammar and Oral Language Development (GOLD) did not achieve a significant mean gain with the use of the Four-Pronged Approach. It may be because they were already at the above-average level of achievement even before the use of the Four-Pronged Approach.

Table 6. Mean Gain of the Participants from the Pre-test to the Post-test in the Control Group

Sub-skills	Mean		Mean Gain	SD	t-Test	Interpretation
	Pre-test	Post-test				
GLR	3.91	4.86	0.95	2.28	1.94	Not Significant
CT	3.00	3.82	1.27	2.14	2.70	Not Significant

Level of Significance: 0.01 Critical Value: 2.831

As can be noted in Table 6, there were no significant mean gains of the participants from the pre-test to the post-test in the Control Group along the four (4) sub-skills, namely: Genuine Love for Reading (GLR) and Critical Thinking (CT). The participants in the Control Group were made to attend the regular class. Although there were improvements in the performance of the participants in their Genuine Love for Reading (GLR) and Critical Thinking (CT) from the pre-test to the post-test, when tested at 0.01 level of significance, t-test values, yielded no significant mean gain.

The data imply that there is really a need to use varied instructional strategies and materials in order to develop the learners' skills in Genuine Love for reading (GLR) and Critical Thinking (CT).

Table 7. Significant Difference Between the Experimental Group and the Control Group

Sub-skills	Experimental		Control		Mean Difference	t-Test	Interpretation
	Mean	SD	Mean	SD			
GLR	7.45	0.77	4.86	1.66	2.18	6.48	Significant
CT	5.64	0.64	3.82	1.70	2.16	4.67	Significant

Level of Significance: 0.01 Critical Value: 2.704

Table 7 stresses a significant difference between the Experimental Group and the Control Group in each of the sub-skills, Genuine Love for Reading (GLR) and Critical Thinking (CT). The sub-skill Genuine Love for Reading (GLR) resulted in the highest mean difference of 2.18, with a t-test value of 6.48 at 0.01 level of significance, and Critical Thinking (CT) with a 2.16 mean difference and a t-test value of 4.67. All these were interpreted as significant mean differences.

It can be inferred that the Four-Pronged Approach was really effective in improving the participants' skills in Genuine Love for Reading (GLR) and Critical Thinking (CT). They attained an Above Average level in the sub skills as compared with the participants in the Control Group.

The participants in the Experimental Group were able to demonstrate better skills in vocabulary, comprehension, writing, making predictions during the pre-reading activities, and while reading; and reading skills such as scanning for information, sequencing events, and paraphrasing.

As to critical and creative thinking, the participants in the Experimental Group manifested active literacy, as in making good guesses about everything around them. It was also found in this study that the grammar and language skills of the participants in the Experimental Group were better improved than the skills of the participants in the Control Group.

5. Conclusion

The significantly different responses of the Experimental and Control Groups show clearly that the participants of the Experimental Group learned better with the use of the Four-Pronged Approach, while the participants of the Control Group demonstrated a slight and negligible improvement in their score.

In the areas of the Four-Pronged Approach, a significant difference existed between the Experimental and Control Groups. This indicates that a reading habit and creative thinking is gradually developing among the participants. Therefore, the practice of the Four-Pronged Approach is effective.

The result that shows that there is no improvement from the pre-test to the post-test of the participants in the Control Group signifies that in teaching any subject, an approach or strategy is crucial to make teaching more effective. In most traditional teaching, learners do not manifest improvement in Genuine Love for Reading (GLR) and Critical Thinking (CT). Varied strategies, technique, and instructional materials are

essential to effect learning especially in Genuine Love for Reading (GLR) and Critical Thinking (CT), which are the skills needed in language development and literacy.

The participants in the Experimental Group exhibited significant improvement in their Genuine Love for Reading (GLR), Critical Thinking (CT), and Transfer Stage (TS) and slight improvement in Grammar and Oral Language Development (GOLD).

The Above Average post-test score profile of the participants in the Experimental Group in Genuine Love for Reading (GLR) means that they had fostered a genuine love for reading, which is a good avenue for the development of vocabulary, comprehension, and writing skills. Therefore, both teachers and parents must engage in the process of helping their children to become literate.

The result that a significant mean gain was achieved by the participants from the Experimental Group in critical and creative thinking denotes that they have been very inquisitive and very creative in finding answers to their queries. They inquired about the how's and why's and were not usually satisfied with the simple affirmative or negative response, with the simple answers to what, who and where questions. Instead they made follow-up queries which seemed infinite and they seemed unsatisfied. When children express themselves, explain their ideas, insist what they perceive to be right, and try to convince adults and playmates or classmates, they actually demonstrate critical and creative thinking.

As cited by Marquez, et al (2009) the significant adults surrounding young learners must be able to identify their quest for information, and that they must attend to these queries by providing the exact, specific, appropriate and correct information. Unfortunately, sometimes, parents and other family members have become impatient or neglectful of the repetitive and endless inquiries of their kids. In this manner, they are depriving their kids of the opportunities to develop their critical and creative thinking skills. They are stopping them from the early attempts to literacy which may be crucial to their formal learning and intelligence.

6. Recommendations

In the light of the findings, conclusions, and implications, the following recommendations are suggested:

1. School administrators must formulate a language-reading program to fit the varying needs of the pupils. They should encourage professional growth among their subordinates in order to continuously improve pupil performance in language.
2. Reading teachers must continuously strive to upgrade and hone their teaching skills in order to motivate and guide the pupils properly. They are tasked to create a reading atmosphere in their classroom. They must be able to identify barriers to critical and creative thinking so that they can guide the young learners as they are exposed to challenging tasks.
3. The family must recognize its vital role in their own child's learning. It can provide and influence their child's literacy through interpersonal, interaction, physical environment, emotional and motivational climate.

4. Pupils should be motivated to master the sub-skills Genuine Love for Reading (GLR) amd Critical Thinking (CT) so that they are able to balance reading and language activities, writing and language activities and, therefore, to transfer language skills to literacy activities with creativity and intellectual challenge.
5. A study on language and literacy is a must in order to develop Genuine Love for Reading (GLR) and Critical Thinking (CT).

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Securitization to reduce CO_2 emission

Dong-Hoon Shin
Department of Global Finance and Banking, Inha University,
Incheon, Korea, e-mail: dhshin@inha.ac.kr.

Changhui Choi
Korea Insurance Research Institute,
Seoul, Korea, e-mail: cchoi@kiri.or.kr

Changki Kim
Korea University Business School,
Seoul, Korea, e-mail: changki@korea.ac.kr

Abstract

We consider CO_2 emission-backed securities designed as a securitization based on national CO_2 emissions. We constructed the securities using data from "CO_2 Emissions from Fuel Combustion" of the International Energy Agency. The securities consist of several tranches with specific coupon rates determined by each nation's probability of threshold (or target emission) achievement. These securities can be traded in financial markets without the interference of other countries and would give countries an incentive to reduce their CO_2 emissions. This study also suggests a financial environmental cleanliness measure for each country using the concept of "green spread" for single-tranche securities.

Keywords: securitization, green, CO_2 emission, green spread, climate change

1. Introduction

The greenhouse effect, the main driver of global warming, is a natural phenomenon, but human activities such as fossil fuel combustion and land use (particularly deforestation) are exacerbating it in ways unprecedented over the last 10,000 years. The Intergovernmental Panel on Climate Change (IPCC) claims that the average temperature of the earth's surface has risen by 0.74^{o} C since the late 1800s, and this trend is expected to accelerate by 1.8^{o} C and 4^{o} C by 2100 if no remedial action is taken (Solomon et al. 2007). As a result, the sustainability of the earth is being threatened by a number of devastating processes: the melting polar ice caps, flooding coastlines, severe storms, changes in precipitation patterns, and widespread changes in the ecological balance.

The main international effort to combat global warming is the United Nations Framework Convention on Climate Change (UNFCCC), an international environmental treaty that took effect on March 21, 1994, with 194 parties participating as of May 2011. The ultimate objective of this treaty is to

achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.[2] While this treaty is legally non-binding and thus enforces no compulsory emission limits, it provides protocols that would set mandatory emission limits. The principal update of this initiative is the Kyoto Protocol, which came into effect on February 16, 2005, with 191 states (excluding the U.S.) among major signatories. The parties to the UNFCCC are classified into three groups according to their phase of economic development and whether they are paying the costs needed to help developing countries attain their goals.[3] Under the Protocol, Annex I countries commit themselves to reducing greenhouse gas (GHG)[4] by 5.2% of 1990 levels for the first commitment period (2008 to 2012).[5]

One of the contributions of this research is its application of the advantageous securitization mechanism to CO_2 emission reduction. We design the securities based on the CO_2 emissions produced by the main emitting countries and illustrate the premium calculation by using CO_2 emissions data. The security issuer would facilitate the securing of funds from capital markets for direct investment into CO_2 emissions reduction. The securities could be sold to sovereign wealth funds, mutual funds, institutional investors, or normal investors, which would increase the attention paid to the CO_2 emissions that decide the size of the securities' premiums. This attention would turn public opinion against any increase in the CO_2 emissions of the main emitting countries. Investors could thus indirectly reduce emissions by simply holding the securities. Naturally, this securitization mechanism can be applied to any harmful gas. This proposal would provide investors with diversified investment opportunities in line with their risk–return profiles.

This study also proposes "green spread," a financial environmental cleanliness measure for each country, in the form of the coupon rate of a single tranche. This measure would give investors an investment barometer and offer each country an incentive to reduce its CO_2 emissions.

The Kyoto Protocol outlines three flexible mechanisms with which the overall costs of accomplishing emission reduction targets can be lowered: emissions trading (ET), the clean development mechanism (CDM) and joint implementation (JI).[6] The ET mechanism is a market-based cap-and-trade scheme in which a regulatory authority enforces a limit (or "cap") on emissions and then allocates or sells permits for emissions to firms. The permits are called "assigned amount units" (AAUs) and are tradable domestically or across nations that have ratified the Protocol. While the ET is a market-based mechanism, the CDM and JI are project-based mechanisms. An Annex I country is eligible to acquire other forms of emission permits if it finances an emission-reduction project in a non-Annex I country under the CDM framework or in another Annex I country under JI. The permits created by CDM and JI projects are called

[2] Article 2, The United Nations Framework Convention on Climate Change, http://unfccc.int/essential_background/convention/background/items/1353.php, Retrieved on November 09, 2011.

[3] Industrialized countries and economies in transition are in Annex I, and a subgroup of these that satisfy the second condition is also in Annex II; a country can be included in both Annex I and Annex II. Developing countries are categorized as non-Annex I countries; 37 countries are categorized as Annex I countries.

[4] The reduction target applies to four greenhouse gases (i.e., carbon dioxide, methane, nitrous oxide, and sulphur hexafluoride) and two types of gases (i.e., hydrofluorocarbons and perfluorocarbons) produced by the former through translation into CO_2 equivalents. The target is set in addition to the industrial gases (i.e., chlorofluorocarbons or CFCs) under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, while international aviation and shipping are not included.

[5] Mandatory reduction targets after the first commitment period are yet to be set despite ongoing negotiations.

[6] For further details, see Hepburn (2007).

"certified emission reductions" (CERs) and "emission reduction units" (ERUs) respectively. The trading of these permits occurs during climate exchanges, which provide a spot market as well as futures and an option market.[7]

The European Union Emission Trading Scheme (EU ETS) and the New Zealand Emissions Trading Scheme (NZ ETS) are the only mandatory emission trading mechanisms; similar initiatives in other countries have been halted or delayed.[8] The EU ETS, launched by the 25 EU countries on January 1, 2005, covers only carbon dioxide (CO_2), including over 11,000 installations; it covers almost half of Europe's CO_2 emissions (Hepburn 2007). The NZ ETS entered into force on July 1, 2010, and aimed to reduce the carbon price to NZ$12.50 until December 31, 2012.[9] The global carbon market stagnated in 2010 at the market value of US$141.9 billion after it recorded consecutive periods of robust growth from 2005 to 2009; the market value had grown dramatically, from US$11 billion in 2005 to US$143.7 billion in 2009.[10] An important feature of this market is the increased dominance of the European Union Allowances (EUAs) market, the value of which grew from US$7.9 billion in 2005 to US$119.8 billion in 2010 constituting 84 percent of the global market value (Linacre et al. 2011).[11] In 2009, a total of US$119 billion worth of allowances and derivatives were traded in the EU ETS, 73 percent of which comprised futures contracts, while the carbon options market reached US$10.6 billion in value (Kossoy and Ambrosi 2010).

A well-functioning market is crucial for successful ET implementation because it is the market under which any movement or volatility in carbon prices is determined. Market efficiency can be improved by introducing carbon derivatives, since these instruments serve as price discovery tools and provide liquidity in the market. Globally, around 84 percent of financial derivatives were over-the-counter (OTC) products in June 2007, and the carbon derivative market is no exception.[12] The key advantages of these OTC contracts are customizability and flexibility; counterparty credit risk can be significant in the absence of a clearing house, and liquidity is limited, especially for exotic risks such as the risk of interest in this paper—GHG emission allowance. Among various noble approaches to constructing derivative products, securitization has been gaining in popularity since its introduction in the late 1970s.[13] In principle, counterparty credit risk can be eliminated by establishing a special entity for cash flow administration that is independent and secured against bankruptcy. The liquidity of these instruments can be improved by structuring their tranches in ways that provide the best possible risk and return profiles to various groups of investors.

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[7] Major climate exchanges include the European Climate Exchange, NASDAQ OMX Commodities Europe, PowerNext, Commodity Exchange Bratislava, and the European Energy Exchange.

[8] Federal cap-and-trade legislation is not supported in the U.S. The Japanese government lost control of the upper house, and the Japanese Basic Act on Global Warming was stalled. The Australian government chose to freeze a domestic trading scheme, and the Republic of Korea's scheme is delayed until 2015 (Linacre et al. 2011).

[9] Emissions trading bulletin No 11: Summary of the proposed changes to the NZ ETS, http://www.mfe.govt.nz/publications/climate/emissions-trading-bulletin-11/, Retrieved on November 14, 2011.

[10] Markets for the primary CDM, the U.S. Regional Greenhouse Gas Initiative (RGGI), and the assigned amount unit (AAU) were main drivers of the stagnation. The primary CDM market fell from US$2.7 billion to US$1.5billion due to regulatory uncertainty after 2012. The latter two markets dropped from US$4.3billion to US$1.1billion collectively, partly because federal cap-and-trade legislation failed to receive enough support.

[11] If the secondary CDM is taken into account, the proportion of the EU ETS rose to 97 percent.

[12] Please refer to Deutsche Börse and Eurex (2008).

[13] Securitization is the process of pooling the assets, liabilities, or cash flows of an issuer or issuers and conveying them to third parties after tranching according to the levels of risk exposure (Banks 2004).

The rest of this paper is organized as follows. Section 2 surveys the relevant literature. Section 3 explains the current status of EU ETS in terms of GHG reduction. Section 4 discusses CO_2 emission modeling along with the Kyoto protocol and data. Section 6 describes the securitization underlying the CO_2 emissions of several countries and the pricing of the securities' premiums. Section 7 concludes the paper with a brief summary and presentation of the main results.

2. Literature Survey

Like all pollution, CO_2 emissions are a kind of negative externality, due to which market prices do not reflect the full costs, as they exclude the impacts of global warming. Emitters thus gain excessive benefits while undermining the welfare of future generations and threatening the environment. Seeking to internalize these external costs, academics, policy makers, and regulators have been focusing on market-based emission reduction mechanisms. Unlike prescriptive command-and-control regulation, market-based mechanisms provide participants with economic incentives to comply, allowing emissions reduction to be achieved more efficiently while producing information on compliance procedures more transparently and also encouraging the development of alternative reduction technologies more actively. Furthermore, regulatory bodies can provide crucial assistance by enforcing emissions allowance allocations. The EU ETS is the world's largest multinational greenhouse gas emissions trading scheme. Covering only carbon dioxide (CO_2), it includes over 11,000 installations. Under this scheme, the right to emit (i.e., an allowance) is allocated as a "European Union Allowance" (EUA); 1 unit of EUA is equivalent to 1 ton of CO_2. These EUAs are treated as commodities; thus, financial derivatives can be constructed based on them. They are also traded in the spot market. The primary concerns of market participants in the spot and derivative markets such as risk management consultants, brokers, and traders are the price behavior and dynamics of this new asset class, CO_2 emission allowances in general and EUAs in particular. The concept of modeling and pricing CO_2 derivatives discussed in this paper differs from the conventional approach to environmental economics and policy studies.

Most of the empirical research on the price behavior and dynamics of allowances is based on the EU ETS since this scheme is rich in liquidity and has a well-developed market mechanism. It is important to note that the scheme's Phase I (2005–2007) and Phase II (2008–2012) should be considered separately in analyses of price behavior due to differences between the market developments. Early studies fail to show consistent results about market efficiency. For example, Uhrig-Homburg and Wagner (2007) found that futures contracts whose maturities expire within Phase I reveal the cost of carry pricing mechanism, while Truck et al. (2007) showed that convenient yield is statistically significant among futures contracts that mature in Phase II. Furthermore, the weak form of market efficiency hypothesis is rejected with spot and futures price data from the Powernext, Nord Pool and EXC because of short-selling and banking restrictions (Daskalakis and Markellos 2008). Moreover, Daskalakis et al. (2005) found that market participants followed conventional no-arbitrage pricing.

Paolella and Taschini (2006) modeled the unconditional tail behavior and heteroskedastic dynamics of CO_2 and SO_2 allowance returns using their econometric structure. The authors found that the unconditional tails can be represented well by the Pareto distribution and the conditional dynamics

approximated by a new GARCH-type structure. Benz and Truck (2009) applied a regime-switching model to model the dynamics of the allowance spot price. Chesney and Taschini (2008) constructed an endogenous model to describe the dynamics of the spot price and demonstrated asymmetric information in the market. Seifert et al. (2008) discussed stylized facts of EU ETS data with a stochastic equilibrium model of a typical economic theory, finding that the CO_2 process does not have a seasonal pattern, and thus has a martingale property, but does have a time- and price-dependent volatility structure.

3. EU ETS and Global CO_2 level

This section discusses the current status of GHG reduction efforts by assessing the EU ETS and its impact on GHG reduction. Since the EU ETS is the first and largest GHG emission certificate trading system, we will use it to appraise current efforts to reduce global GHG emissions.

The effectiveness of the EU ETS is a matter of ongoing debate. Its achievements include being the first working emission trading system and obtaining some carbon emissions reductions from participating members. On the other hand, some have criticized it for an excessive flexibility, an overestimation of GHG emissions by many members, superfluous grandfathering (e.g., the granting free-of-charge certificates), the encouragement of fraud and profiteering, and the exclusion of the countries responsible for most of the world's GHG emissions.

First, let us discuss some of the research on the effectiveness of the EU ETS. Martin Muûls and Wagner (2012) performed a thorough search of the literature on the EU ETS, reviewing a total of 179 research papers. Some of these evaluated the EU ETS' effect on CO_2 emissions. Anderson and Di Maria (2011) estimated that there was a 2.8% reduction in CO_2 emissions from BAU (business-as-usual) in Phase I, considered the pilot period for the EU ETS.[14] Anderson and Di Maria (2011) considered various factors affecting CO_2 emissions (such as the economy, weather, and price of electricity) to construct BAU estimates and compared them to actual CO_2 to produce an estimation of 2.8% CO_2 reduction in Phase I. The estimated 2.8% reduction in CO_2 emissions claimed by Anderson and Di Maria (2011) is similar to the claim in Ellerman, Convery, and De Perthuis (2010) that the CO_2 emission reduction in Phase I (2005–2007) was around 3.3% from BAU (or 70 MT per year). Another noteworthy study on EU ETS' impact on CO_2 emission reduction is Abrell, Ndoye, and Zachmann (2011), who matched the firm information database in CITL with AMADEUS[15] to estimate the CO_2 emissions reductions of Phases I and II (2008–2012). Matching CITL data to AMADEUS data was challenging because they had to match the addresses of 3,680 installations (one company may have more than one installation). According to the authors, CO_2 emissions reduction was 3.6% lower in Phase II than in Phase I. However, since Abrell, Ndoye, and Zachmann (2011) did not consider exogenous factors, some of the 3.6% drop in CO_2 emissions seen in Phase II might have been caused by other factors, such as the economy, weather, and energy prices. Martin, Muûls and Wagner (2012) provide more research results on CO_2 emissions reductions during the EU ETS.

[14] A 2.8% reduction in CO_2 emissions for parties to the EU ETS is equivalent to 58 MT (metric tons) of CO_2 per year.

[15] The CITL is a transaction log for EU emission trading data, and AMADEUS is a commercial database distributed by Bureau Van Dijk to most European firms.

Despite the numerous research findings that support the effectiveness of the EU ETS, its cap-and-trade system has been criticized. For example, Gilbertson and Reyes (2009) have criticized many aspects of the EU ETS.

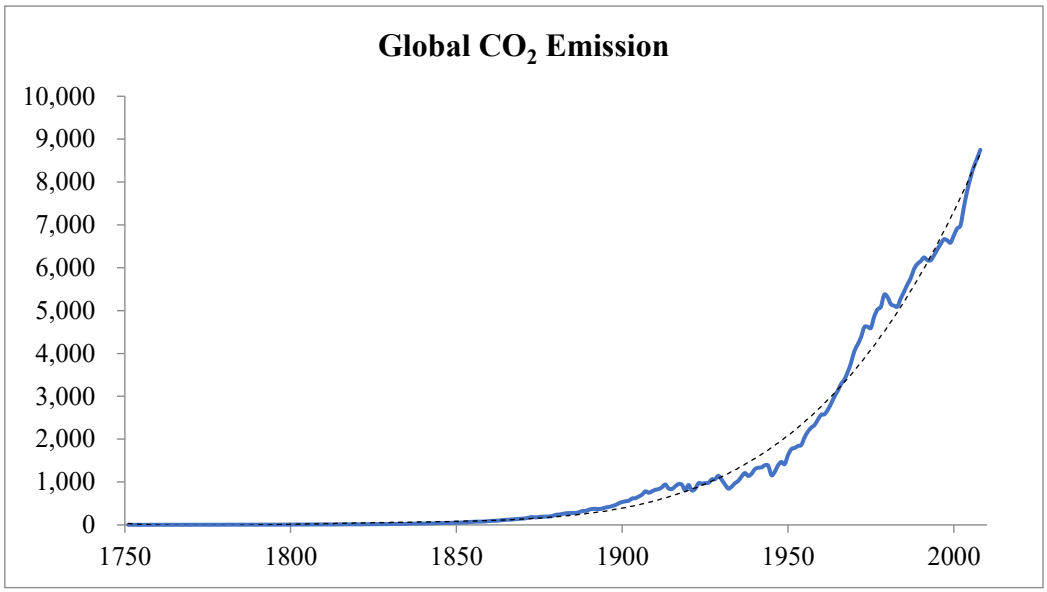
First, they claim that its flexibility allows some of its members to emit more CO_2 rather than strive for reduction. The flexibility of the EU ETS leads to excessive grandfathering (i.e., issuing CO_2 emission certificates free of charge), inaccurate assessments of the CO_2 emissions of participating members, and the use of CDM and JI. Anderson and Di Maria (2011) showed that the EUA quantities for European countries during Phase I were unbalanced: excessive EUA were assigned to some countries and insufficient EUA to others.[16] According to Gilbertson and Reyes (2009), installations that needed to emit more CO_2 could simply purchase certificates from countries with excess permits instead of trying to develop technologies to reduce CO_2 emissions. This tendency to pass the responsibility for reducing CO_2 emissions onto others was worsened by excessive grandfathering.[17] Furthermore, Gilbertson and Reyes (2009) also criticized CDM and JI for sponsoring projects that have failed to improve the environment. Some EU ETS members were also accused of exploiting CDM and JI[18] instead of trying to reduce CO_2 emissions.[19] The fact that purchasing CO_2 emission certificates is usually cheaper than reducing CO_2 emissions for most energy companies has also been criticized.

Despite the criticisms, the EU ETS is the first working GHG emission trading system to help reduce GHG emissions. Viewed from a wider perspective, however, EU ETS' efforts have had an insignificant impact on global GHG levels, largely through the nonparticipation of heavy CO_2 emitters. For example, the Bush government rejected the Kyoto protocol in March 2001 and announced in February 2002 that the U.S. would rely on domestic voluntary action to reduce GHG emitted by the U.S. economy by 18% over the next 10 years[20] (the downward trend in U.S. CO_2 emissions between 2007 and 2009 may be due to the global financial crisis of the same period). In 2010, Canada, Japan, and Russia announced that they would not accept new Kyoto commitments. Canada then withdrew from the Kyoto Accord entirely in December 2011, probably because Canada was not going to be able to avoid paying a $14 billion penalty for failing to meet its goal without repudiating the Accord. Canada also argued that the Kyoto protocol cannot work because the U.S. and China (the world's largest GHG emitters) are not participating in it[21] (China and India, two major GHG emitters, were not included among Annex I countries because they are classified as developing countries).

Figure 1 below shows historical global CO_2 emissions.[22] The dotted line is a fourth-order regression line with R^2=0.989.

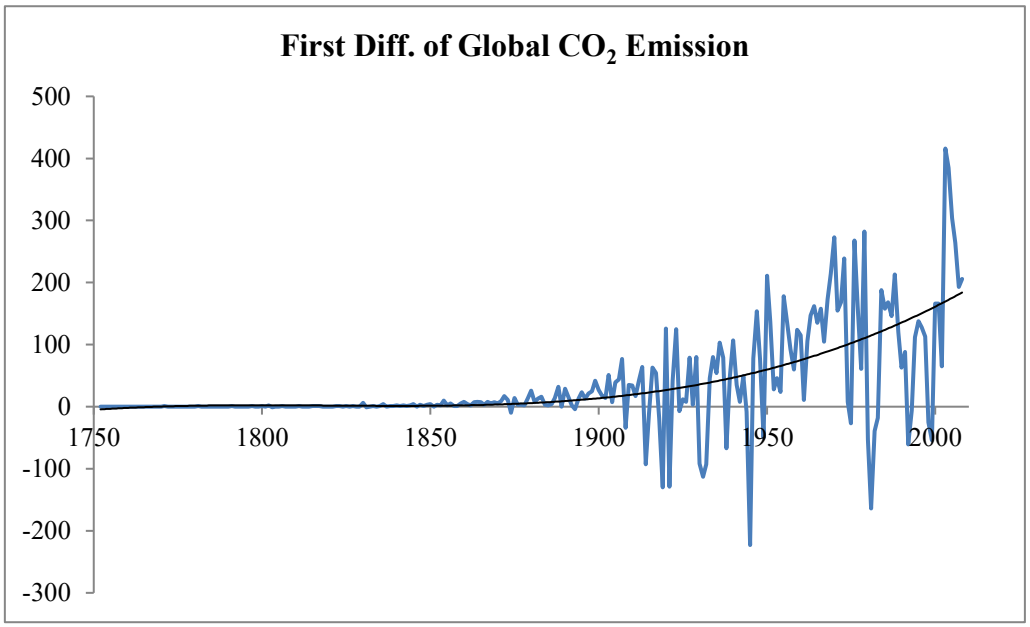
Figure 1: Global CO2 emissions between 1751 and 2008 in metric tons

[16] The Czech Republic, France, Germany, and Poland had excess EUA, while Spain, Italy, and the UK did not have enough.
[17] The daily closing price of EUA spots plummeted in 2006 and 2007 when EU ETS participants realized that the supply of permits exceeded demand.
[18] CDM and CI can be traded for CO_2 emission certificates.
[19] Gilbertson and Reyes (2009) also mention that entrepreneurs in India and China built factories whose primary purpose was to produce GHG. These entrepreneurs have made billions of dollars by trading their GHG emissions through CDM and JI.
[20] http://www.eoearth.org/article/Kyoto_Protocol_and_the_United_States, an article in *The Encyclopedia of Earth*.
[21] "Canada pulls out of Kyoto protocol," *The Guardian* (UK). December 13, 2011.
[22] Boden, T.A., G. Marland, and R.J. Andres (2010). Global, Regional, and National Fossil-Fuel CO2 Emissions.



The first differences in yearly CO_2 emissions can be seen in Figure 2. Figures 1 and 2 show that we are emitting around 9,000 million MT of CO_2 each year. It is expected that an additional 200 million MT of CO_2 will soon be emitted each year. As mentioned, Anderson and Di Maria (2011) found a 2.8% reduction in CO_2 emissions from BAU during Phase I of the EU ETS, and Abrell, Ndoye, and Zachmann (2011) estimated that CO_2 emissions reduction was 3.6% lower in Phase II than in Phase I (keeping in mind, as noted, that the latter finding is probably overestimated). As already explained, a 2.8% reduction from BAU in the EU ETS is equivalent to 58 MT per year. Given that global CO_2 emissions per year total around 9,000 million MT, with an additional 200 million MT increase expected each year, we can see that EU ETS' endeavor has a long way to go.

Figure 2: First differences in global CO_2 emissions between 1751 and 2008 in metric tons



We are suggesting a new approach to resolving the global GHG emissions issue—a financial commodity that will restrain the GHG emissions of UNFCCC nations through securitization. This study proposes that the financial markets can settle the external diseconomies of GHG emissions and that scholarly research can solve real-world problems. The advantages of the proposed financial commodity are as follows:

1. The securities pay more coupons when GHG emissions are reduced. Hence, the investors in these securities will try to foster GHG emissions reductions.

2. Governments that invest in these products will have an incentive to reduce GHG emissions, solving problems related to a shrinking CO_2 emissions market and the nonfulfillment of international agreements on carbon emissions.

3. Institutional and private investors will become concerned about carbon emissions, which may lead to concern for the environment.

4. Since the securities have a zero or negative (for Russia) correlation with the financial market, they may help to diversify financial markets.

5. If the GCF (Green Climate Fund) becomes the issuer, these securities would be good tools for helping the GCF raise fund and address GHG emissions reduction.

We need to accurately price and design the correct commodities to obtain sufficient market demand. This task requires analyzing the emissions data from various angles and referring to many studies.

This section has discussed the research on the EU ETS and has indicated that it has been ineffective in reducing the drastically increasing global CO_2 emissions. Global GHG reduction requires the active participation of heavy GHG emitters, the enforcement of international regulations, and the use of both financial and non-financial instruments. This study attempts to develop an effective financial instrument for GHG reduction.

4. CO_2 Emissions Modeling and Expanded Kyoto Protocol

4.1 CO_2 Emissions Modeling

First, global self-immolating reduction efforts are most important for overall CO_2 emissions reduction. The 2011 withdrawal of Canada from the Kyoto Accord shows that international agreement on emissions reduction is not enough; real effort is required. Thus, a mechanism that can induce real reduction efforts among nations is needed. Such a model or financial commodity should be linked to the amount of CO_2 emissions each nation produces and should control this amount. To construct the model, we need national data on CO_2 emissions. Since the financial model should induce emission reductions until a specific time, within a specific amount, the expected emission amounts must be estimated.

The data on CO_2 emissions must be such as to guarantee the clarity and reliability of the measurement. Some subjects, such as animals and trees, are not suitable for use in measuring emissions because they generate obscure measurement problems and are thus not suitable as underlying assets for financial commodities. We therefore limit the subject of CO_2 emissions to fossil fuels. Fossil fuels are not

only related to other emitting subjects, such as automobiles and factories, but are also an influenceable factor in total CO_2 emissions. In addition, data on the CO_2 emissions from fuel combustion of all countries are publicly available through international organizations such as the IEA (International Energy Agency) and EIA (Energy Information Administration). We used the IEA's time-series data on CO_2 emissions, ordered by country, covering 1971 to 2010. We also price the security premiums using data on the top three GHGs (i.e., CO_2, CH_4, and N_2O).

For the given time-series data, we need to estimate the expected emissions amount after a few years. Most studies (e.g., Mastrandrea and Schneider 2005; den Elzen and Mainshausen 2006; Jones, Cox and Huntingford 2006) consider much longer periods, such as 100 or 200 years and thus cannot be applied to financial commodities. We will estimate the emission amounts within shorter spans, of fewer than 10 years.

4.2 Expanded Kyoto Protocol

The revision accepted at COP18 (the 18th Conference of the Parties to the UNFCCC) extended the commitment period by three years, making it from 2013 to 2020. If we call α the emission reduction target suggested by the Kyoto Protocol, then Annex 1 countries should reduce their GHG emissions by (1+ α) times their emission amount in 1990.

In 2010, the top 10 CO_2-emitting nations were Canada, China, Germany, India, Iran, Japan, South Korea, Russia, the UK and USA, which emitted 65.50% of the world's CO_2. Among these, the Annex 1 nations were Canada, Germany, Japan, Russia, and the UK. Though Canada withdrew, this paper will include Canada for the securitization and will calculate the premium based on the cumulative CO_2 limits suggested by the Kyoto Protocol. Table 1 summarizes the target reduction basis, CO_2 amounts in 1990, and the permitted CO_2 emissions data for the five countries.

Table 1: Emission reduction targets and GHG emission amounts of the top five countries

unit: Tg CO2 equivalent

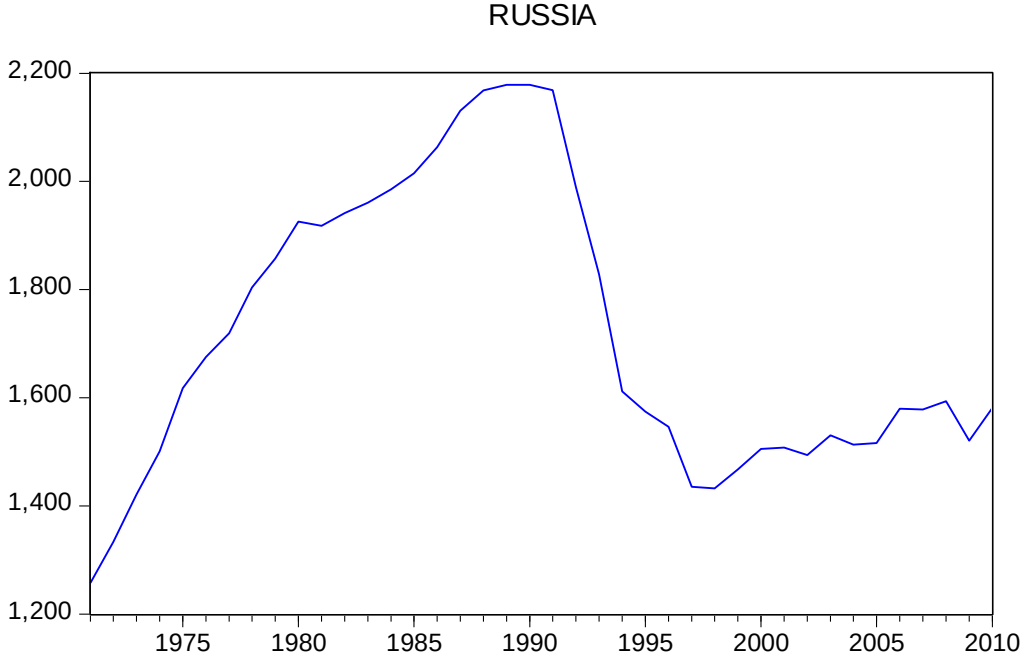
Top 5 countries in Annex 1	Emission reduction target	CO_2 amounts in 1990	Permitted cumulative CO_2 emission amounts during second period	GHG amounts in 1990	Permitted cumulative GHG emission amounts
Russian Federation	0%	2,559.6	20,476.8	3,471.1	27,769.0
Japan	-6%	1071.0	8,053.92	1,258.5	9,463.8
Germany	-8%	1014.2	7,464.5	1,230.3	9,055.0
UK	-8%	591.8	4,355.6	785.0	5,777.4
Canada	-6%	384.5	2,891.4	532.5	4,004.4

Table 2 summarizes the statistics on CO_2 emission increases for the five countries.

Country	Mean	STD	Jarque–Bera	P-value
Canada	5.051282	13.94321	2.245775	0.325339
Germany	-5.5641	28.10613	1.172992	0.556273
Japan	9.853846	38.62117	0.548827	0.760018
Russia	8.305128	72.37046	21.63193	2.01E-05
UK	-3.58974	18.66279	1.874165	0.391769
Russia(1995~)	-1.8875	46.37873	1.360495	0.506492

Table 2 shows that Russia's Jarque–Bera statistics are particularly high. At the end of 1991, after the collapse of the Soviet Union, Russia suffered political instability and inflation until president Putin seized power. Russia's CO_2 emissions, rapidly increasing since 1970, peaked in 1991, then dramatically decreased until they reached 70% of their 1991 level, and then stabilized. Therefore, only post-1995 Russian data should be used. The increase in Russian CO_2 emissions rejects the unit root (ADF: -3.5373) and has a low Jarque–Bera statistic (1.36).

Figure 3: Annual Russian CO_2 emissions amount data[23]



The post-1995 Russian data and the other four countries' time-series data do not reject Jarque-Bera normality, implying that the increases in annual CO_2 emissions are stable and follow a normal distribution. An important component of this study is estimating the cumulative emission amounts from 2013 to 2020. Let S_t be the CO_2 emissions of a country at t year, and $\Delta S_t := S_t - S_{t-1}$ be the increase in CO_2 emissions at t year. Let T_0 be the start year of the second commitment period and $A_{T_0,T} := \sum_{i=0}^{T-T_0} S_{T_0+i}$ be the

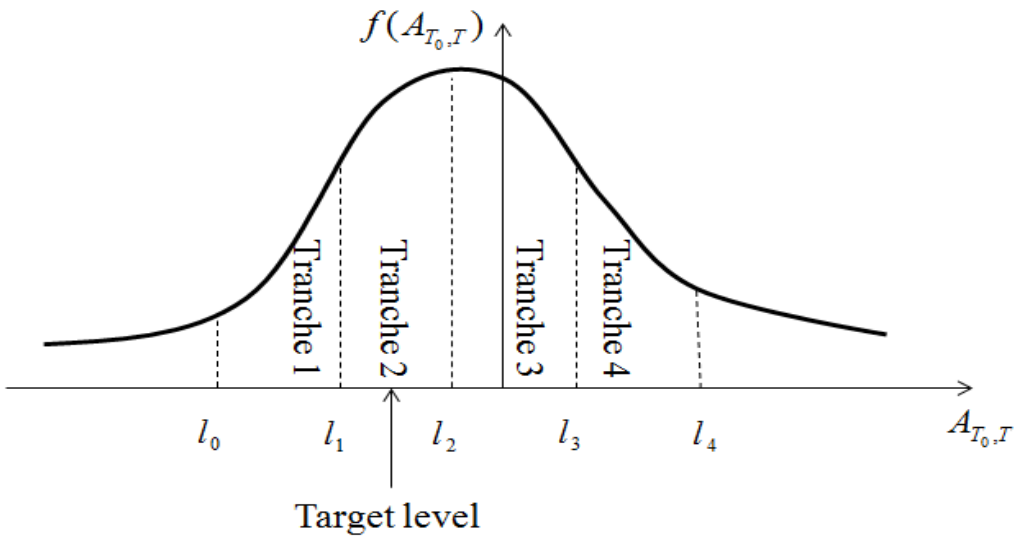
[23] IEA Co2 emissions from fuel combustion 2012
http://www.iea.org/statistics/topics/co2emissions/

cumulative CO_2 emissions amount until T year. To calculate the future cumulative CO_2 emissions amount $A_{2013,2020}$ based on the Kyoto Protocol, we generate ΔS_t with the given mean and variance in the increase in CO_2 emissions and calculate $S_t=\Delta S_t+S_{t-1}$. Finally, we obtain $A_{T_0,T}$ by integrating S_t's.

5. Designing and Pricing the Securities

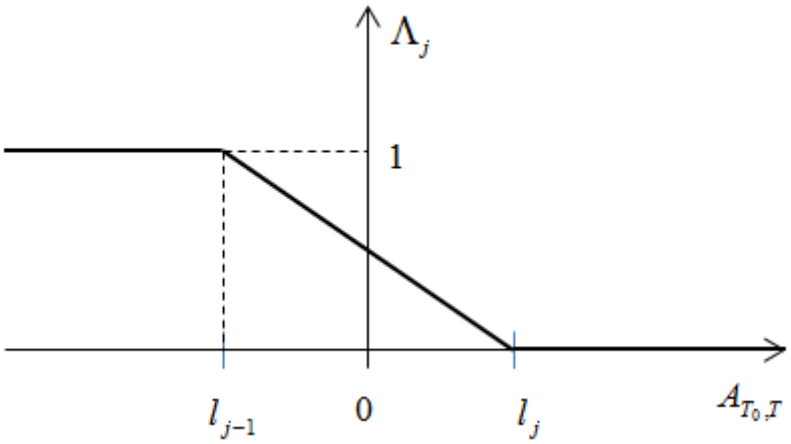
This section prices the security premiums based on cumulative CO_2 emission amounts. We suppose that $A_{T_0,T}$ have bell-shape distribution whose probability density function (pdf) has many frequencies on the medium values and little on either tail. We divide the distribution of $A_{T_0,T}$ into several tranches, by which the coupon of a security belonging to each tranche increases as the frequency of the tranche decreases. Finally, we need to design a security mechanism that will enable a country to belong to a low frequency tranche if it sits below the emissions reduction target level suggested by the Kyoto Protocol. Consider Figure 4 below.

Figure 4: An example of a distribution of $A_{T_0,T}$ and tranches



Let $f(A_{T_0,T})$ be the pdf of $A_{T_0,T}$, and consider the example with three tranches on the distribution of $A_{T_0,T}$. For four real numbers, $l_j, j \in \{0,1,2,3,4\}$, let tranche j be the interval $[l_{j-1}, l_j), j \in \{1,2,3,4\}$. If $A_{T_0,T}$ belongs to a specific tranche, a security on that tranche should have a payoff decided by the value of $A_{T_0,T}$. To construct the payoff for each tranche j, consider Figure 5 below.

Figure 5: An example of a payoff function on the security



Through simple math, the payoff of tranche j can be decided by

$$\Lambda_j := \frac{[l_j - A_{T_0,T}]_+ - [l_{j-1} - A_{T_0,T}]_+}{l_j - l_{j-1}},$$

where $[a]_+ := \text{Max}\{a, 0\}$, for real number a.

These securities have higher coupons the lower a nation's value for $A_{T_0,T}$ at maturity. Let the annually paid coupon of the security belonging on tranche j be C_j. Assume that the annual coupon C_j has paid constantly until maturity. If one invests an amount of money N_j at the starting time of a security, a constant C_j would be paid annually until maturity, and C_j and N_j will be paid together at maturity. If r is the risk-free interest rate, as the present value of the sum of all cash flows should be equal to the notional value, we have

$$N_j = E_Q\left[\sum_{i=1}^{T-T_0} C_j e^{-ri} | S_t\right] + N_j e^{-rT}, \ t \le T_0 \qquad (1)$$

where t is the most recent year of reported CO_2 emissions data, and generally $t<T_0$. Let s_j be the risk premium of the security. Since C_j should be rational to the national N_j, the payoff function Λ_j, and the risk premium s_j, we can define

$$C_j := \Lambda_j N_j (s_j + r) \qquad (2)$$

Substituting (2) into (1), we have

$$N_j = E_Q\left[\sum_{i=0}^{T-T_0} \Lambda_j N_j (s_j + r) e^{-ri} \,\middle|\, S_t\right] + N_j e^{-r(T-T_0)}$$

$$= N_j(s_j + r)\sum_{i=0}^{T-T_0} E_Q[\Lambda_j | S_t]e^{-ri} + N_j e^{-r(T-T_0)} \quad (3)$$

Solving (3) with respect to s_j, we have

$$s_j = \frac{1 - e^{-r(T-T_0)}}{E_Q[\Lambda_j|S_t]\sum_{i=1}^{T-T_0} e^{-ri}} - r = \frac{1 - e^{-r}}{E_Q[\Lambda_j|S_t]e^{-r}} - r \quad (4)$$

Here, since $E[E_Q[\Lambda_j|S_{t+i}]|S_t] = E_Q[\Lambda_j|S_t]$, $i > 0$, the second equation of (4) holds.

6. Numerical Examples

6.1. Based on Expanded Kyoto Protocol

This section generates scenarios, $S_{t-1} := S_t + \Delta S_t$, and creates ΔS_t. For ΔS_t, we investigate its historical mean and variance and assume that ΔS_t is distributed normally. Based on this assumption and the reduction plan of Kyoto Protocol, we calculate premium s_j numerically.

We take the UK as an example. Data from the IEA indicate that the UK's 2010 CO_2 emission amount was 483.52 Tg. During the 40 years from 1971 to 2010, the first difference in CO_2 emissions data follows the normal distribution, with a mean of -3.59 Tg and a variance of 18.66 Tg. Since the second reduction commitment period is from 2013 to 2020, the UK's 2013 CO_2 emissions amount, S_{2013}, is the following:

$$S_{2013} = S_{2010} + 3\mu + \sqrt{3}\sigma\varepsilon = 483.52 + 3 * (-3.59) + \sqrt{3} * 18.66 * \varepsilon, \qquad \varepsilon \sim N(0,1)$$

The UK's permitted cumulative CO_2 emissions amount during the second commitment period (assigned amount) is the following:

$$\text{assigned amount} = 1990\text{'s level} * (1 + \alpha) * 8 = 4042.49$$

See Table 1 for the value of α and 1990's level.[24] We set $\{l_0, l_1, l_2, l_3\}$, the boundaries of the tranches, as {α-0.04, α-0.02, α, α+0.02, α+0.04}, and calculate them as

$$l_0 = 1990\text{'s level} * (1 + \alpha - 0.04) * 8 = 3866.73$$
$$l_1 = 1990\text{'s level} * (1 + \alpha - 0.02) * 8 = 3954.61$$
$$l_2 = 1990\text{'s level} * (1 + \alpha) * 8 = 4042.49$$
$$l_3 = 1990\text{'s level} * (1 + \alpha + 0.02) * 8 = 4130.37$$

[24] In this equation, we used the value of the 1990 level (549.2514). This is from the IEA dataset and is slightly different from the value in Table 1 extracted from the Kyoto Protocol. The difference may be caused by the difference in estimating methods between the IEA and the Kyoto Protocol, but it is not significant to this paper. We used only the IEA's data throughout.

$$l_4 = 1990's\ level * (1 + \alpha + 0.04) * 8 = 4218.25$$

Since we can compute $E_Q[\Lambda_j] = \frac{E_Q[l_j - A_{T_0,T}]_+ - E_Q[l_{j-1} - A_{T_0,T}]_+}{l_j - l_{j-1}}$ from each tranche, we can find the value of (4). The results are as follows:

$\{s_1,\ s_2,\ s_3,\ s_4\} = \{0.00837, 0.00535, 0.00333, 0.00200\}$

Table 3 below shows the CO_2 emission amount distributions of the top five countries in Annex 1 and the risk premiums of the tranches.

Table 3: The risk premiums of the securities underlying the CO_2 emission amount

unit: Tg CO_2 equivalent

Top 5 Annex 1 countries	Emission amounts in 2010	Mean of the increase	Variance of the increase	s_1	s_2	s_3	s_4
Russian	1581.37	-1.89	46.39	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
Japan	1143.07	9.85	38.62	7.30110	3.61261	1.87948	1.02566
Germany	761.58	-5.57	28.11	0.00080	0.00039	0.00018	10^{-4}
UK	483.52	-3.59	18.66	0.00837	0.00535	0.00333	0.00200
Canada	536.63	5.05	13.95	>10	>10	>10	>10

The values of the spreads for Japan and Canada are greater than 100%. The Canadian spreads are extremely high; it would thus be inappropriate to issue securities.

Tables 4 and 5 show the results of similar premium calculations using data on the top three GHG emission amounts and the total GHG emission amount,[25] respectively.

Table 4: The risk premiums of the securities underlying the top three GHG emission amounts

unit: Tg CO_2 equivalent

Top 5 Annex 1 countries	Emission amounts in 2010	Mean of the increase	Variance of the increase	s_1	s_2	s_3	s_4
Russian	1540.90	-92.38	161.48	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
Japan	1161.28	1.32	34.05	0.61698	0.32920	0.18503	0.10854
Germany	938.67	-13.40	24.62	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
UK	574.95	-9.12	17.27	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
Canada	754.54	12.17	100.32	0.44314	0.40278	0.36656	0.33402

[25] http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3814.php.

Table 5: The risk premiums of the securities underlying the total GHG emission amounts

unit: Tg CO_2 equivalent

Top 5 Annex 1 countries	Emission amounts in 2010	Mean of the increase	Variance of the increase	s_1	s_2	s_3	s_4
Russian	1569.42	-95.08	164.82	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
Japan	1208.33	-2.51	39.57	0.05769	0.03667	0.02349	0.01503
Germany	1208.33	-13.07	24.53	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
U. K.	605.40	-8.98	18.07	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$	$<10^{-4}$
Canada	772.83	12.02	100.62	0.42976	0.38935	0.35322	0.32088

The differences among the countries' spread values in the top three and total GHG data seem to be smaller than those in the CO_2 data. However, the values for Canada and Japan are still higher than those of the other countries.

Table 6: The sensitivity of the risk premium of the Canadian securities under ΔS_t and the tranche intervals

The Canadian reduction target, $\alpha = -0.06$

ΔS_t	[-0.11,-0.09]	[-0.09,-0.07]	[-0.07,-0.05]	[-0.05,-0.03]	[-0.03,-0.01]
0	>10	>10	>10	>10	>10
-5	>10	>10	>10	9.35995	4.05191
-10	4.74291	2.43371	1.09289	0.66079	0.34447
-15	0.40183	0.23396	0.13621	0.08488	0.05485
-20	0.06125	0.03842	0.02534	0.01653	0.01048

Table 6 presents scenarios designed to investigate which ΔS_t values and tranche intervals are appropriate for issuing Canadian securities to financial markets. As Table 6 shows, to have a roughly 10% coupon level, the Canadian security should have a [-0.07, -0.05] tranche interval, and Canada should consistently reduce 15 Tg of its CO_2 emissions a year.

However, this calculation methodology is based on the expanded Kyoto Protocol, the emissions standards of which are based on 1990 emission levels. As the political and industrial situation is much different from what it was in 1990, it is not appropriate to apply Kyoto Protocol standards to the security pricing. We thus introduce a more intuitive, simple, and practically applicable construction method for tranche design and risk premium pricing for each tranche in the next subsection.

6.2. Practical Application

Let us consider a way to reduce the expected cumulative GHG emissions amount from 2013 to 2020, $A_{2013,2020}$. For example, we can set

$\{l_0, l_1, l_2, l_3, l_4\} = \{94\%, 96\%, 975\%, 99\%, 100\% \text{ of } A_{2013,2020}\}$.

Table 7 presents the results of $s_j, j = 1, 2, 3, 4$, the risk premiums for the new tranches $[l_{j-1}, l_j]$.

Table 7: The risk premiums of the securities based on the practical approach

Top 5 Annex 1 countries		Russian Federation	Japan	Germany	UK	Canada
CO2	$r + s_1$	0.05559	0.07622	0.06242	0.05991	0.10914
	$r + s_2$	0.04190	0.05120	0.04512	0.04395	0.06406
	$r + s_3$	0.03299	0.03669	0.03431	0.03383	0.04127
	$r + s_4$	0.02706	0.02789	0.02736	0.02726	0.02884
3GHG	$r + s_1$	0.03066	0.08552	0.08627	0.07238	0.03346
	$r + s_2$	0.02855	0.05504	0.05534	0.04956	0.03021
	$r + s_3$	0.02685	0.03811	0.03822	0.03606	0.02768
	$r + s_4$	0.02552	0.02820	0.02822	0.02775	0.02574
All GHG	$r + s_1$	0.03061	0.07311	0.09106	0.07351	0.03363
	$r + s_2$	0.02851	0.04987	0.05725	0.05005	0.03031
	$r + s_3$	0.02683	0.03618	0.03891	0.03625	0.02773
	$r + s_4$	0.02551	0.02778	0.02836	0.02780	0.02575

The premium levels in Table 7 seem to be more practical and stable than those in Tables 3, 4, and 5, indicating that the method of setting the tranches proposed in this subsection is more appropriate for designing and pricing the securities.

7. Green Spread: A Clean Environment Indicator

This section uses the proposed method of calculating security premiums to deduce a measure of environmental cleanliness for each country based on their CO_2 emission amounts. One common tranche is assumed in calculating the security spread for each country. The calculated spreads represent increases or decreases in CO_2 emissions in each country and can thus serve as an index of environmental cleanliness in each. Reduced CO_2 emissions reduce the size of the spread and increase the probability of achieving the targeted CO_2 emissions reduction. This spread, the "green spread," can be a financial measure of environmental cleanliness for each country. Suppose the single tranche has upper bound *u* and lower bound *l*. To get the green spread s, we apply these boundaries to the equation (4). Then the formula for the green spread is expressed as

$$s = \frac{1-e^{-r(T-T_0)}}{E_Q[\Lambda|S_t]\sum_{i=1}^{T-T_0} e^{-ri}} - r = \frac{1-e^{-r}}{E_Q[\Lambda|S_t]e^{-r}} - r, \quad (5)$$

where

$$\Lambda := \frac{[u - A_{T_0,T}]_+ - [l - A_{T_0,T}]_+}{u - l}.$$

To calculate this spread, we set a tranche limit based on the previously established value of $A_{2013,2020}$,

covering l=95% and u=100% of $A_{2013,2020}$.[26] The single tranche spread is an indicator of cleanliness. It is financially interpreted as follows: if a county emits significant CO_2, the green spread would increase, meaning that the country should pay more to keep its environment clean.

We calculate the green spreads of a few countries and compare them. For reference, we use the CDS spread of each country. The comparative analysis with interpretations of the green and CDS spreads is shown in Figure 7.

Figure 6: The comparison between CDS Spreads and green spreads of countries.

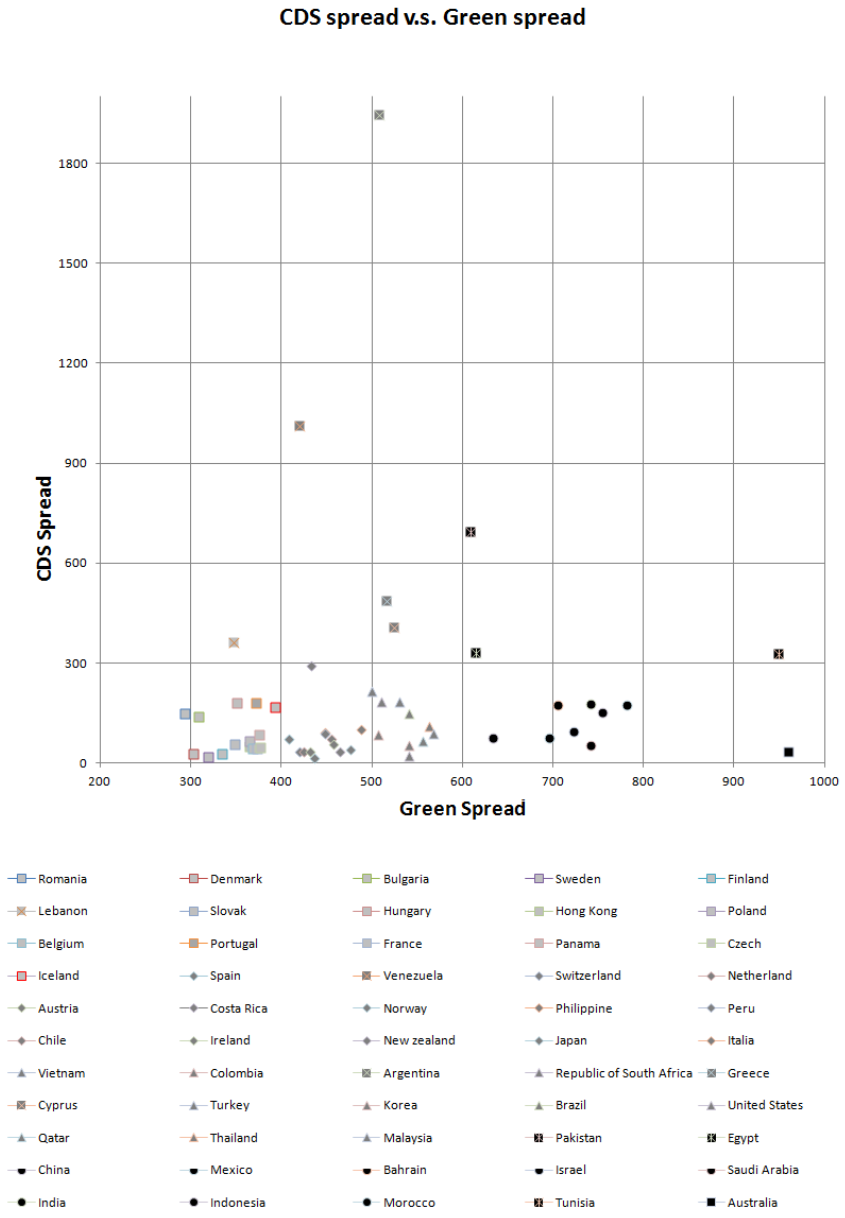


Figure 6 exhibits CDS spreads and green spreads of various countries. We categorized countries into three groups based on their green spread; countries with small green spread (below 400 bp), countries with

[26] The first attempt was to set lower and upper tranche limits at 1% and 99% of $A_{2013,2020}$ respectively. The result was too large to be considered as a spread of interest rates.

medium green spread (above 400 bp and below 600 bp), and countries with large green spread (above 600 bp). These groups were further broken down into distinct sub-groups based on their CDS spread; one whose CDS spread is below 300 bp and the other whose CDS spread is above 300 bp. Table 8 shows the lists of respective groups that are classified based on their green spread and CDS spread.

Table 8: 6 groups of countries classified by CDS spread and Green spread

Green / CDS	Less than 400bp	400bp to 600bp	Over than 600 bp
Over than 300bp	Lebanon	Venezuela, Argentina, Greece, Cyprus	Pakistan, Egypt, Tunisia
Less than 300bp	Romania, Denmark, Bulgaria, Sweden, Finland, Slovak, Hungary, Hong Kong, Poland, Belgium, Portugal, France, Panama, Czech, Iceland	Spain, Switzerland, Netherland, Austria, Costa Rica, Norway, Philippine, Peru, Chile, Ireland, New Zealand, Japan, Italia, Vietnam, Colombia, Republic of South Africa, Turkey, Korea, Brazil, United States, Qatar, Thailand, Malaysia	China, Mexico, Bahrain, Israel, Saudi Arabia, India, Indonesia, Morocco, Australia

The first group (countries whose green spread is below 400 bp and CDS spread is below 300 bp, the second column of the third row) are the ones with low default ratio and clean environment. On the other hand, the third group on the third row (countries whose green spread is above 600 bp and CDS spread is below 300 bp) bears small credit risk. Yet, pollution seems to be in progress in the countries in this group due to recent economic development. Lebanon, that is the only country in the fourth group, exhibits a high default ratio and a low degree of pollution. Finally, the countries in the last group (countries whose green spread is over 600 bp and CDS spread is over 300 bp) seem to have unstable economies and polluted environments.

The correlation between the cleanliness and credibility of each country seems low, at about 0.07, as seen in Table A1 and Figure A1 in the appendix. Though little correlation between them is evident on the surface, these two variables are influenced by several practical factors, such as level of economic development and national environmental policy. This may imply that studying the correlation between two variables without any control over the relevant factors is meaningless. Therefore, the correlations must be reexamined after controlling for all the factors that could influence the two variables.

Cleanliness and credibility shows significant differences at the 5% level, as seen in Table A2 and Figure A2, when we categorize countries on each continent based on geographical factors. Africa and Oceania show the lowest cleanliness levels, mainly due to deforestation and mineral mining, respectively; Asia, America, and Europe follow. The high number of developing countries in Asia and America cause their low cleanliness levels compared to Europe's. For credibility, North America and Oceania show the highest levels, with USA and Australia representing a huge portion of their continents, due to their low credit risk. South America and Africa show the lowest levels due to their lower stages of development and politic instability. However, the correlations between cleanliness and credibility were neither consistent nor significant once divided by continent.

Table A3 and Figure A3 present the members and non-members of the OECD (Organization for Economic Cooperation and Development). Neither cleanliness nor credibility show significant differences at the 5% level. However, as expected, OECD members with higher levels of economic development and environmental awareness show higher cleanliness and credibility than those of non-members. The correlation between cleanliness and credibility was not significant after separating OECD members from non-members.

Table A4 and Figure A4 present the BRIC (i.e., Brazil, Russia, India, China) group. Rapidly developing BRIC countries show lower cleanliness and higher credibility, which were not significantly different from those of other countries at the 5% level. The differences were not significant, as expected. This result has two causes: the mixture of various cleanliness and credibility factors among BRIC non-members and the insignificant deviations of BRIC values from the average. The correlation between cleanness and credibility was not significant after separating BRIC members from non-members.

Table A5 and Figure A5 consider the PIIGGS (i.e., Portugal, Italy, Ireland, Greece, Great Britain, Spain) group. Their cleanliness and credibility are not significantly different from those of other countries at a 5% level. High cleanliness and low credibility were expected due to their slow growth rates and the impact of the financial crisis. Their cleanliness is somewhat higher than that of non-PIIGGS nations, while their credibility is similar to that of non-members. However, a clear difference is seen between PIIGGS and BRIC nations: the declining PIIGGS show higher cleanliness and lower credibility than the rising BRICs. The correlation between cleanliness and credibility was not significant after separating PIIGGS members from non-members.

Table A6 and Figure A6 show advanced countries (based on IMF criteria) and non-advanced countries. The cleanliness of the advanced countries is not significantly different from that of the other countries at a 5% level, but their credibility is significantly different, also at a 5% level. The advanced countries clearly show higher credibility than the non-advanced countries based on credit risk, but the cleanliness gap between the advanced and non-advanced countries narrows due to the rapid growth of countries such as China. The correlation between cleanliness and credibility was not significant after separating the advanced

from the non-advanced countries.

Table A7 and Figure A7 present countries with and without Kyoto targets (Annex I in the Protocol). Countries with targets show a significantly higher level of cleanliness and credibility at a 5% level. The credibility result occurs because many highly developed countries, especially in Europe, have compulsory Kyoto targets. The cleanliness levels of countries with Kyoto targets can be explained by their lower growth rates compared to developing countries and their strong commitment to the Kyoto targets. The correlation between cleanliness and credibility was not significant after separating countries with Kyoto targets from those without.

8. Conclusion

Given the intensity of global climate change, the GHG reductions mandated by the Kyoto Protocol should be implemented faithfully. However, implementation has been difficult because the United States refused to ratify the agreement, and Canada, Japan, and Russia failed to join the second round of carbon cuts. Although the second commitment period was extended by three years, we need to induce as many countries as possible to reduce their GHG emissions by approaching the issue from a new angle.

If the securities linked to national GHG emission amounts designed in this study are issued by UNFCCC or GCF, the investors holding the securities will become participants in GHG emission reduction. For example, if the UK reduces a significant amount of its CO_2 emissions after issuing the securities, investors holding them will have a high probability of making a mint and will therefore request more effective reduction activities of the UK government.

We used the distributions of the increases in CO_2 emissions from 1971 to 2010 for the top five CO_2-emitting Annex 1 countries through data published by the IEA. Evaluating the expected increases in emission from 2013 to 2020, we computed the sum of the CO_2 emissions during the second commitment period and calculated the risk premiums of the securities associated with the tranches whose expected rate would be the same as the risk-free interest rate.

The Russian, Japanese, German, and UK CO_2 emission-backed securities have relatively stable risk premiums or spreads, but the Canadian security is impossible to issue because of its much higher spread value (the sizes of the CO_2 emission amounts between 1990 and 2010 are larger than those of other nations). We identified the Canadian security with a stable coupon spread: Canada should reduce 15 Tg of its CO_2 emissions each year. In addition, we proposed a way of constructing the tranches based on the expected cumulative GHG emission amounts, which are different from those in the Kyoto Protocol, providing more practical and stable risk premiums.

The green spread would act as an indicator of each country's environmental cleanliness. Our analysis using green spreads found no correlation between cleanliness and credibility, even after controlling for geographic, economic, and other factors. Cleanliness should be examined separately, without considering credibility. A higher level of cleanliness is observed in Europe, OECD nations, and countries with Kyoto targets. Africa, Oceania, OECD non-members, and countries without Kyoto targets show lower levels of cleanliness.

We expect that issuing the proposed securities will inspire investor concern about national GHG reduction activities and influence overall public opinion on the issue. Finally, investigating coupon spread calibration methods under risk aversion or reduction duty and developing a methodology for generating CO_2 emitting scenarios for short time spans remain for future research.

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Appendix

Table A1. Pearson correlation with the Green coupon rate and the CDS rate

	Green	CDS
Green	1.00	
CDS	0.07	1.00

Table A2. Green coupon rate by region

	Number	Sum	Mean	Variance
Africa	4	2,857	714	36,905
Asia	15	8,552	570	17,005
Europe	24	9,872	411	9,179
North America	3	1,670	557	17,557
Oceania	2	1,424	712	122,602
South America	7	3,254	465	3,297
Total	**55**	**27,629**	**502**	**23,911**

Table A3. Green coupon rate by OECD membership

	Number	Sum	Mean	Variance
OECD	28	12,878	460	19,706
Non-OECD	27	14,751	546	25,249

Table A4. Green coupon rate of BRIC and non-BRIC

	Number	Sum	Mean	Variance
BRIC	3	1,917	639	10,135
Non-BRIC	52	25,712	494	23,760

Table A5. Green coupon rate of PIIGGS and non-PIIGGS

	Number	Sum	Mean	Variance
PIIGGS	5	2,243	449	3,410
Non-PIIGGS	50	25,386	508	25,749

Table A6. Green coupon rate of advanced countries and non-advanced countries

	Number	Sum	Mean	Variance
Advanced	26	12,002	462	19,752
Non-Advanced	29	15,626	539	25,560

Table A7. Green coupon rate of Annex I parties of Kyoto protocol and non-Annex I countries

	Number	Sum	Mean	Variance
Annex I	27	11,590	429	16,514
Non-Annex I	28	16,039	573	21,427

Figure A1. Main countries

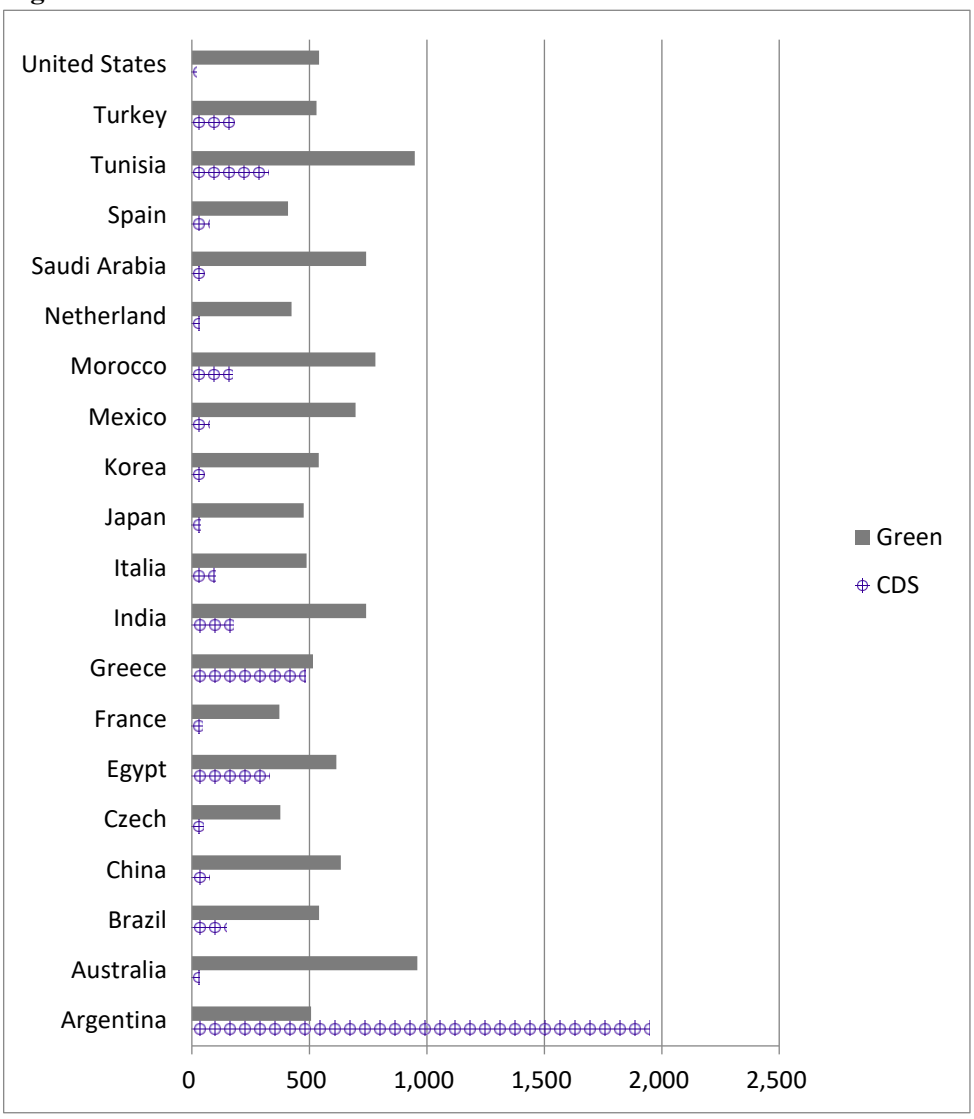


Figure A2. By region

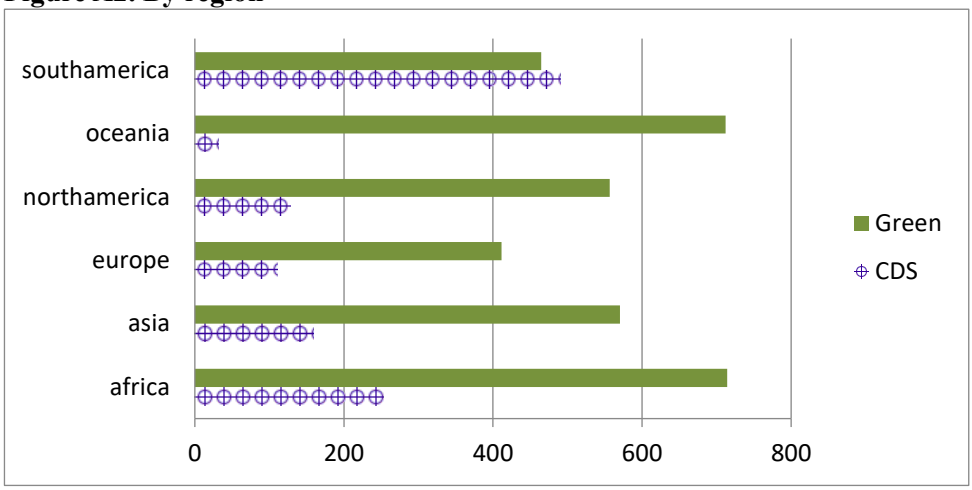


Figure A3. OECD vs. non-OECD

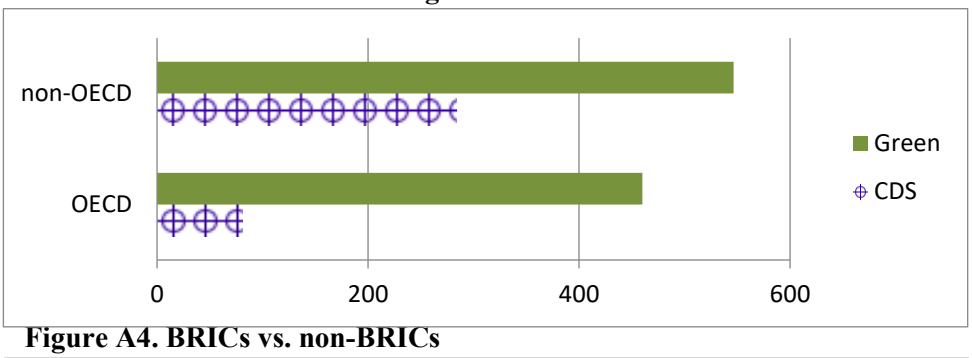


Figure A4. BRICs vs. non-BRICs

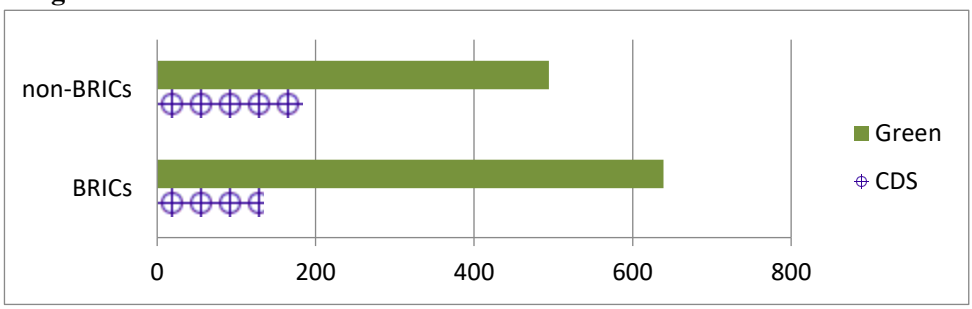


Figure A5. PIIGGS vs. non-PIIGGS

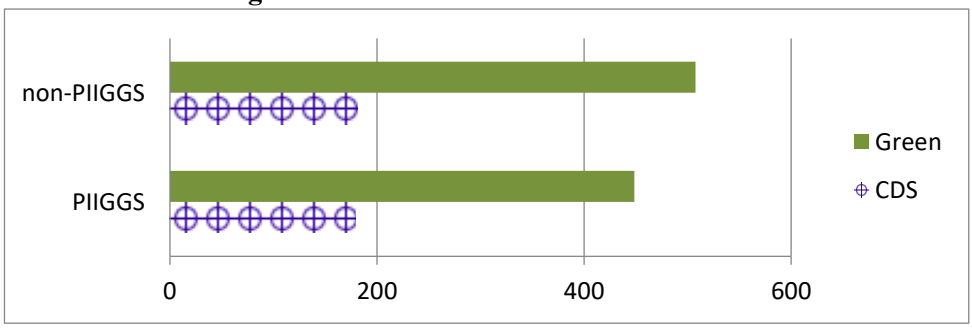


Figure A6. Advanced vs. non-advanced

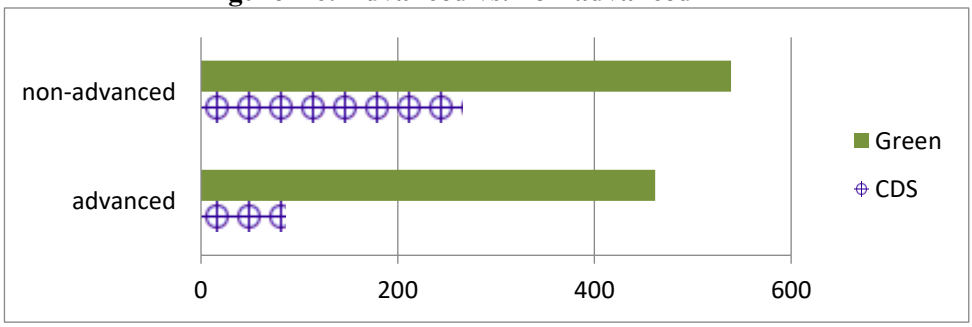
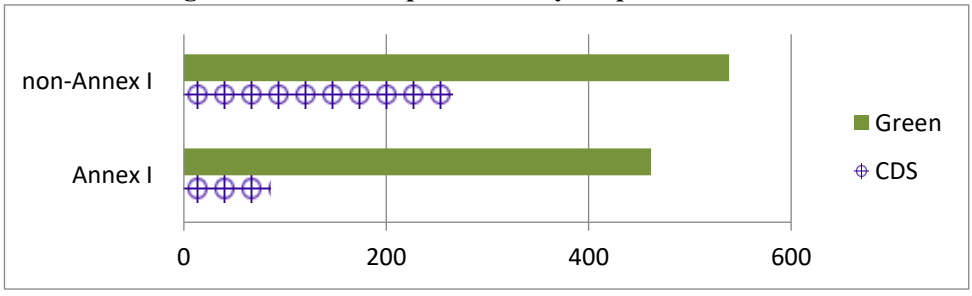


Figure A7. Annex I parties of Kyoto protocol vs non-Annex I countries



Innovative Teaching Design of Topology based on Information Technology

Hongkui Li
School of Mathematics and Statistics, Shandong University of Technology,
Zibo, China

Abstract

Information technology as a means of teaching has gradually integrated into the curriculum, and the corresponding teaching design is also closely followed. The ability training of undergraduate students in mathematics should be permeated in the classroom teaching, and the use of rich Internet to collect mass teaching resources can effectively promote the enthusiasm of students' learning, which is beneficial to the formation of students' innovative consciousness and practical ability. This paper discusses the innovative teaching design of topology.

Keywords: Information technology; topology; innovative

1. Introduction

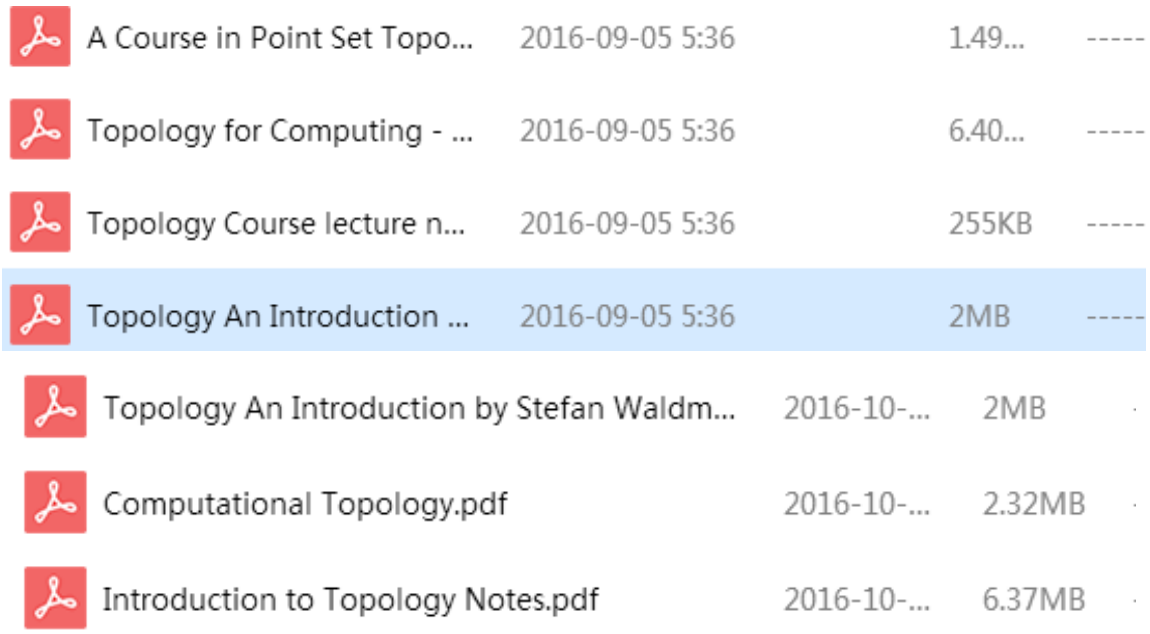
"Topology" is different from other courses in mathematics, such as mathematical analysis, higher algebra, differential equation and other courses, has almost no content, logic, and abstract content, and the basic concepts of it are much more. "Topology" is more difficult for learners. In the textbook, after introducing some concepts, it is often followed by a series of theorems and verbose proofs. Examples are few, and the examples in the textbook are also abstract. In the classroom, we should adopt more questions, check, dredge and feedback in time. To prepare lessons carefully before class, make courseware, grasp the key and difficult points in the teaching materials, and actively search for materials related to the teaching materials to help students understand every problem and difficulty. In class, we should teach carefully in class, seize the key points, highlight the difficulties and elaborate the practice, use a variety of teaching methods, start from the knowledge level of the students, strive to cultivate the students' interest in learning, arouse the enthusiasm of the students, and maximize the democracy in the classroom, create a lively atmosphere, let the students think happily and actively explore. Ask, dare to challenge, dare to be new. In the teaching, we should pay attention to the combination of theory and practice, pay attention to the practical problems encountered in the practice of the students, explain the problems in theory, and put forward the methods and measures to solve them, and actively cultivate the students' ability to do it.

2. Instructional design

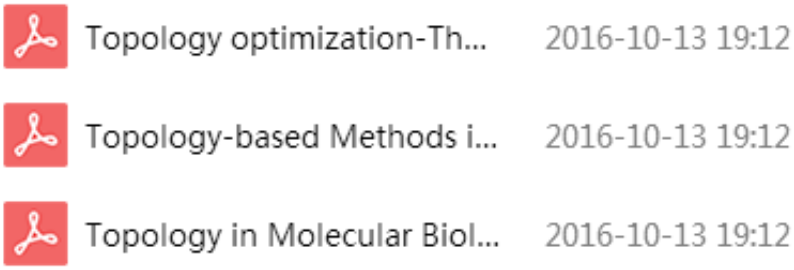
Because most of the students in mathematics are motivated to study and continue to study, the innovation of these students is mainly in the innovation of professional knowledge, that is, to write scientific research papers. At the same time, the concepts, theories and methods of topology have been widely permeated into

many fields of modern mathematics, natural science and social science, and have an increasingly important application. Therefore, the basic knowledge of learning point set topology can not only provide necessary basic knowledge for learning modern mathematics, but also from higher view. Point to observe and analyze the contents of mathematics, deepen the understanding and understanding of these contents. According to the characteristics of the course of topology, in the course of preparing the lesson, not only the content of the textbook is carefully prepared, but also the relevant literature of the course is searched and collected. The concrete measures are as follows:

1. In order to facilitate communication, every course of the semester first establishes the QQ group before class.
2. In order to improve students' professional English level, we collected and uploaded foreign electronic English textbooks related to topology in QQ group (a few screenshots are listed below).



3. In order to enhance students' understanding of the application of topology, collect and publish the literature on topology application related to this course in QQ group(a few screenshots are listed below).



In order to improve the students' innovation and the writing ability of scientific and technological papers, in the course of preparing lessons, collect and upload the literature on theoretical innovation related to the content of the course at any time, guide the students to find innovative ideas, and continue to innovate and write the papers in combination with the literature of the application.

3. Conclusion

On the basis of the above measures, at present, a number of subjects have been declared and completed in school level teaching and reform. "Analytic geometry" course has been rated as a provincial-level excellent course, and more than 10 articles related to "topology" are written and published for students majoring in mathematics and Applied Mathematics in their spare time.

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Information and Communication Technologies in the Training of Health and Education Professionals

Maykon Anderson Pires de Novais
Department of Informatics in Health (1)

Márcia Mello Costa De Liberal
Department of Medicine - Discipline of Economics and Management in Health (1)
Center for Humanities - Faculty of Social and Applied Sciences (2)

Paola Zucchi
Department of Medicine - Discipline of Economics and Management in Health (1)

Solange Aparecida Nappo
Department of Preventive Medicine (1)

(1) Federal University of São Paulo (Unifesp)
(2) Federal University of Western Bahia (Ufob)

Corresponding Author:
Paola Zucchi - Rua Botucatu, 740 – 4º andar, Vila Clementino, CEP: 04023-900, São Paulo/SP, Tel.: (11) 5576-4848, e-mail: pzucchi@unifesp.br.

Abstract

The training of health and education professionals is by various sources of information and specific actions. The content analysis that focus on knowledge of these professionals to empower themselves reveals very encouraging results, as the knowledge they possess. With this, the objective is to consider the information sources in the context of information and communication technologies as tools to aid health professionals and education in their professional training. From this context, the quick access to the right information for these professionals is one of the most efficient ways to combat drugs and its consequences. The text describes the influence of Information and Communication Technologies in the universe of health and education. This presence is decisive for the process of professional training.

Key words: Information and Communication Technology, Training, Health, Education.

1. Introduction

One of the milestones of this epoch is the problems related to the abusive use of psychoactive substances [1]. In Brazil, crack cocaine, defined as a "devastating drug", stands out due to its physical and social effects. Easy access and low cost made the drug a worrying dimension for public health [2]. Crack has been breaking social and geographical barriers [4], posing a challenge for health professionals and educators regarding the prevention of their use and treatment of dependents. Among the difficulties to deal with this issue is the need to improve the qualification of health professionals who will work in the assistance of users and their relatives [5], as well as teachers of Elementary and Middle School, who have a great role in the prevention of use [3].

This training faces difficulties that go beyond the knowledge of scientific concepts. Epidemiological indicators show that crack consumption is increasing in Brazil [4], reason enough for information on the subject to be constantly improved. However, more than this quantitative increase, reflected in a greater number of users, the emergence of new forms of drug consumption, as well as changes in the culture of use and new drug associations [2]. Soares and Campos [6] show concern with the subject when they affirm that the scientific production on the subject drugs is abundant with respect to the pharmacological aspects of the drug itself and the treatment of dependence, as traditionally. It has been focus in the area of health, but characteristics related to the user's behavior, the usage culture and the problems associated with it are few information. The qualification of the health professional occurs through several sources of information and specific actions. As training is fundamental, the activity of the health professional is being reflect by efficient and effective practical actions.

Bucher [7] analyzing information on drug prevention programs, further states that for prevention to be link to a non-perverse but true ethic, it is necessary to rely on clear and truthful information. Therefore, the construction of more effective preventive actions, with the aim of minimizing the problem of drug abuse, will depend on the type of information one has on the subject, favoring more tolerant or more restrictive attitudes depending on the constructed archetype. However, the sources of information that help to elaborate these actions are diverse and, when unreal or distorted, can cause more problems than benefits. Sometimes they do not express the real situation they can be loaded with ideologies derived from moral and religious values of those who disseminate them or with errors of scientific conceptualization. Furthermore, the author can ignore the epidemiological picture of Brazil highlighting drugs whose use does not exist and does not even constitute a public health problem or can often create strategies based on the "pedagogy of terror" to drugs, ineffective.

Among the possibilities of using content, we can see Information and Communication Technologies as an opportune vehicle for access to information. The analysis of contents that focus on the knowledge of health professionals and education on empowerment reveals little encouraging results, as for the knowledge they have, for example, in the area of drugs. There is a paradoxical picture, for example, the increase in drug consumption and the constant changes in the culture of use of these substances and the lack of preparation of professionals considered "decisive" to deal with this problem.

In other words, the most used sources of information contribute to the perpetuation of this paradoxical picture. Added to this is the fact that much, if not all, of scientific knowledge is produced in large university

centers, making it difficult for those who are distant to access it, which is a true cultural segregation. In this constantly changing scenario, rapid, complete and reliable information must be available and accessible to health professionals and teachers, so that they act based on reality, respecting the peculiarities of the place where they intend to intervene. Canoletti and Soares [8] corroborate this assertion when he argues that the production of information in health seems to reflect a stage of experimentation in which guidelines and proposals are been produced, but only centers of excellence in the area and governmental institutions, report on the development of prevention programs per se.

Sancho and Hernandez [9] emphasize that the impact that ICT has caused on people's daily lives is very visible, as it has affected many aspects of life. At work, it caused many professions to disappear and others to emerge. It has also changed culture, leisure and even the economic world. There are people who have grown up having contact with ICT as part of their routine. It has become difficult to deny the changes that technology has brought to the world. However, these changes are not always positive for the whole society. This paradox of benefits and oppositions that the TICs offered, especially to the computer science, a bias of study and perception. Continuing education is fundamental in the field of health sciences, due to the enormous amount of new data generated by the rapid growth of knowledge in the area [10]. The large amount of information that exists in the various education and training channels makes the use of these tools and accesses a challenge of knowledge implantation and recruitment. Therefore, the construction of more effective preventive actions, with the aim of minimizing the problem of drug abuse, will depend on the type of information one has on the subject, favoring more tolerant or more restrictive attitudes depending on the constructed archetype. However, the sources of information that help to elaborate these actions are diverse and, when unreal or distorted, can cause more problems than benefits.

In this constantly moving scenario, rapid, complete and reliable information must be available and accessible to health and education professionals, so that they act based on reality, respecting the peculiarities of the place where they intend to intervene. Thus, the construction of more effective preventive actions, with the aim of minimizing the problem of drug abuse, will depend on the type of information one has on the subject, favoring attitudes more tolerant or more restrictive, depending on the constructed archetype. However, the sources of information that help to elaborate these actions are diverse and, when unreal or distorted, can cause more problems than benefits.

In the current context of the 21st century, Information and Communication Technologies (ICTs) are an important tool to find, disseminate and deepen the scientific information developed in centers of excellence, which represent the most adequate parameter of evidence for health decision making. In this sense, the purpose of this text is to analyze the ICTs, in the universe of education and health professionals, in their communication process and as sources of information for their professional qualification.

2. The Communication Process

The classical process of knowledge construction has taken place over the years, mainly in education, in the linear form of transmitter-receiver. With the advent of ICTs, this process is been energized and a new form of communication begins to prevail in human society. In the contemporary scenario, the subject happens to be as someone who has consciousness and only accepts what he desires. In this sense, it is observed that

the construction of knowledge is been influenced directly by cultural factors, based on individual history and related to the information coming from the environment in which the person lives.

According to Valente [11], "the way the process of meaning, understanding and appropriation of information happens is not the object of communication." The author also adds that the “education has a fundamental role and a commitment to help the recipient- subject - the apprentice - to build their knowledge." At this point, communication and education differ both in their function and in the field of study. Therefore, in this process of knowledge construction, ICTs can be extremely useful in the educational field as cognitive tools that play different roles.

3. The Sources of Information and Their Technologies

The researches in the Brazilian scientific bibliography by studies that analyze the information and the formation of the health and education professionals returned results not very encouraging. We can call technology textbooks, printed and electronic media, for example. The textbooks [12] are the teacher's main vehicle of information. Being a source almost unique to the teacher, the book has great importance as a provider of knowledge for these professionals. Carlini-Cotrim [12] analyzed eighteen Brazilian textbooks and found that there is a discrepancy between what is focus on books and reality. The drugs most mentioned in the books studied were tobacco and alcohol, followed by marijuana, cocaine, heroin, morphine and opium. This list of drugs contrasts with the epidemiological distribution of drug use in the country, resulting in a very different approach to reality. For example, heroin, morphine and opium are drugs that are not widely consumed by the Brazilian population.

In relation to the print media, the transmission of knowledge by some vehicles (newspapers, magazines specialized in the dissemination of knowledge) is been characterized by the indeterminacy of its receivers (lay public). They do not explain the conditions of production (diversity of its producers: who speaks, where does it speak, to which group it belongs), by the variety of the genres of discourse on the same knowledge (scientific discourse, didactic discourse, journalistic discourse etc.). In this way, the analysis of drug content in newspapers and magazines detects that, although alcohol is the most consumed psychotropic drug among Brazilians and causes several health problems, including deaths, not most cited in these texts, losing for marijuana, which has not shown to have the same alcohol-killing potential [14].

As for electronic media, especially the internet, teachers' knowledge about ICTs, their frequency of use, and the types of applications that support the classroom routine, found that 60% of the interviewees knew about these technologies. However, with regard to computing, none of them had advanced knowledge, concentrating only on the basics. The most cited tool to help in class was PowerPoint, with the Internet being the least used [15]. Observing the behavior of nurses in Basic Health Units, Vargas and Luis [16] have concluded that there is a little knowledge of nurses on the subject of alcohol and alcoholism. Therefore, they suggest the capacity to prepare them for care, recognition and the prevention of alcohol use /abuse disorders in basic health care units, as there is evidence that users of this abusive substance are significantly present in these services. In an analysis of physician training to provide assistance to drug users.

Cruz and Filho [5] have concluded that academic training for drug user assistance is been considered insufficient for the physicians interviewed. Training based on a predominantly biological model, aimed at

assisting the most acute and severe cases, does not enable physicians to perform early identification and deal with issues such as relapse, inconsistency of treatment demand, aggressiveness, comorbidities , clinical complications and the social family situation.

Regarding teachers, in an analysis of the perception and attitude of teachers of private and public schools in relation to drugs, Ferreira, Sanchez et al. [3] evaluated that, although these professionals recognize themselves as opinion makers, they do not consider themselves sufficiently qualified to deal with the subject with their students. Even either because of their lack of information, interest or ability to approach the subject. In terms of the information on the subject, there was a low perception about the risk associated with licit drugs.

This paradoxical picture between increased drug use, constant changes in the culture of substance use and the lack of preparation of professionals considered decisive to deal with the problem of abuse may explain part of the failure of consumer prevention initiatives. On the other hand, the most used sources of information contribute to the perpetuation of this situation. Added to this is the fact that much, if not all, of scientific knowledge is produced in large university centers, making it difficult for those who are distant to access it, which is a true cultural segregation.

The production of information in the area seems to reflect a stage of experimentation in which guidelines and proposals are produced, but only the centers of excellence in the area and governmental institutions, particularly at the federal level, can report on the development of prevention programs as such [8] . In that sense, access to information systems, ICTs and computer-mediated education mechanisms can offer great access gains, but also provide erroneous and unsafe information. The impact of ICTs on people's daily lives is very visible because it has affected many aspects of life. In the field of work, it has caused many professions to disappear and others to emerge. It has also changed culture, leisure and even the economic world. There are people who have grown up having contact with ICT as part of their routine. It has become difficult to deny the changes that technology has brought to the world today, but these changes are not always positive for society as a whole [9].

This paradox of benefits and oppositions offered by ICTs, especially computer science, consists of a bias of study and perception. The internet has brought many changes in the lives of people and highlights benefits such as ease of thinking, writing, synthesizing thinking, rereading and correcting texts on certain subjects, as well as providing a great opening to the world, generating different possibilities of access to information diversified [17]. Continuing education is also fundamental in the field of health sciences, due to the enormous amount of new data generated by the rapid growth of knowledge in the area [11]. The large amount of information that exists in the various education and training channels makes the use of these tools and accesses a challenge of knowledge implantation and recruitment. Therefore, in the area of health, informatics brings together knowledge and skills in the use of information technologies and care and education actions.

4. Information and Communication Technologies - ICTs

Faced with the demand for communication that is been offered to us, we realize that new discoveries and incorporations of technology as a tool for knowledge and work are inevitable. According to Rodrigues and

Colesanti [18], since the 1990s, the advent and popularization of the internet have presented a new displacement of this "gravitational center", which implies numerous transformations for human life, especially with regard to circulation of knowledge and all the new possibilities and forms of knowledge provided by the global network. In this scenario, ICTs arise, which are, in general, processes and artifacts that interconnect communication and the transfer of data and information. It is very important to consider the World Wide Web as one of the resources that popularized the internet and made it accessible for public in general. Therefore, the internet is a product of Information Technology.

According to Santos [19], ICTs "consist of devices produced by human ingenuity for the purpose of obtaining, storing and processing information, as well as establishing communication between different devices, enabling such information to be disseminated or shared." The term "new information and communication technologies" came in the 1980s, when new options emerged to support the development of machines and devices designed to store, process and to transmit large amounts of information [20]. In this scenario, computers and the Internet are great examples of ICTs today, as they are facilitators of the process of searching for information and how to know people communicates with one another.

5. ICTs in the Educational Universe

We can realize that the school do not be restricted to simply transmitting content, having knowledge centered on the teacher exclusively, but rather, being democratic in expanding and offering the opportunities for the construction of knowledge, individual and collective, without regional distinction, financial, cultural or ethnic background. For Valente [11], the information transmitter posture, from the communicational point of view is focus on the concept of transceiver, widely used in the mass media. In this case, the receiver has be seen as a vessel that should be fill and everything that come from the transmitter should be accept by the receiver.

In the educational environment, ICTs have become present, either indirectly, when the student brings with him in his smartphone, or when the institution provides technological means to mediate education. The latter seems still to be an objective to be achieved due to the preconceptions and limitations that professionals have in using technological resources to mediate teaching-learning practice. From these observations, we can derive many benefits from the use of information technology in education and the absorption of information, be it formal or informal. The use of technology in education is a clear path to the process of democratization of access to information.

There are two different types of possibilities of using information technology in education [11], the computer as a teaching machine and the computer as a tool. It is possible to conclude that the computer as a teaching machine is associated with an instructional approach, which only indicates the offer of information and as a tool to a constructivist approach, when it allows the student to construct his own knowledge. The analysis of these two models leads to define that the instructional base refers to the technological media as mere means of transmitting information and the constructivist base is been related to the process of elaboration of capacity.

The use of information and communication technologies in education is a path with no return to the teaching-learning process. At present, the use of cell phones in public schools, for example, begins to

released, contrary to what has always occurred, that is, its deliberate ban in the classroom. It is also important to mention that ICTs today have a great overcoming power. It is a state-of-the-art technology at a time is easily outdated at a future time. That said this metamorphosis requires of the people a great capacity of adaptation and overcoming. The electronic media also play an important role in the process of socialization and education of the individual, since they interact with it in an intimate way. The phenomenon has grown with the advent of technological enhancement, which is particularly effective in private educational institutions. These make these resources even a tool for the sale of products, while in public institutions the adherence is slow and not very immersive. This point is been criticized since mere technological insertion does not necessarily represent a gain in productivity, including intellectual gain.

The use of information and communication technologies in education is a path without a return to the teaching-learning process, even if it is restricted to different education professionals yet. This challenge imposed on education professionals is been confronted with the reality experienced in many institutions, mainly public, which lack the preparation and technological material to accompany the transition from a content reality to one in which the formation of new knowledge is predominant. Education, today more than ever, needs to be rich in resources, enabling its public to construct new knowledge and develop its capacity to think, create, express itself, participate and decide [21].

The ICTs in the educational universe are more than the use of simple technological tools. They can be understand as the implementation of a new didactic-pedagogical method that will guide education in the 21st century. One can no longer think that the application of a technological resource represents the insertion of education into a technological universe. The uses of computer tools may be the simple transposition of technologies from earlier centuries to the present moment. What will decide the insertion of these technologies in the educational universe will be the paradigmatic change of teachers and students, who will take advantage of the most accessible technological resources to incorporate new methods of teaching and of learning. Therefore, technologies and information technology are not the end of learning, but should be considered as a means of stimulating the development of new teaching and learning methodologies.

6. ICTs in Health Universe

For the American Medical Informatics Association Health Informatics boils down to “applying the principles of computer science and information to the advancement of life sciences, education, healthcare professionals and patient care" [22]. This multidisciplinary and integrative field focused on health information and communication technologies develops their own areas of approaches and differentiates them from other professions and disciplines. In this area, Information and Communication Technologies (ICTs) occupy, at these moment, evidence of applicability in the health field that needs to be adequately explored by teaching and pedagogical approach in the training of professionals. Informatics in the educational process has provided a great service allowing a high degree of interactivity between the student and the knowledge, besides offering attractive environments for learning with the use of educational applications. [23].

The Imia (International Medical Informatics Association on Education in Biomedical and Health

Informatics) describes the recommendations for medical education where it is possible to visualize the importance of its implications. For the Association there is relevant evidence that health information technology improves the training of professionals to develop, implement and evaluate their work systems [24]. Therefore, the necessary transformations in educational systems will require the integration of new information and communication technologies, not only as a means to improve the efficiency of systems, but, mainly, as pedagogical tools in the service of the formation of the individual.

7. Conclusion

ICTs are present in all contemporary areas of activity in such a way that it is practically impossible to imagine that a health professional can effectively exercise his profession without the aid of this resource at the present time. In the universes of health and education, the demand for these digital technologies that help the execution of tasks inherent to each medical specificity is increasing. In this context, the internet has become an indispensable tool for the accomplishment of the numerous processes that require updating of data in permanent update.

So it is also worth noting that in addition to the use of these technological tools for emergencies, these new health information resources are vital for the monitoring and surveillance of diseases and treatments, including supply chain management and all the pedagogical and logistical aspects that are, in fact, quite relevant to global health. In this sense, these new technologies are been considered appropriate and of great use in the training of health and education professionals, since they can facilitate the dissemination of knowledge to sectors lacking information such as drug prevention, to other problematic areas of Public Health.

In the specific case of drugs, the need for constant updating of the professionals involved in their prevention or treatment is essential, since the changes that occur in the cultures of the use of these harmful substances to individuals and to society as a whole strongly interfere in the severity of the social, organic and psychological complications suffered by users. Therefore, we can say that, with the popularization of digital technologies, we are all experiencing an innovative relationship between quantity, speed and way of creating and disseminating information. This makes possible a series of communicational, social and cultural transformations in the health area, enhancing not only the emergency, but also the urgency to establish new ways of thinking, of feeling and of acting professionally. It also establishes unprecedented ties of coexistence from a new structural dynamic in terms of the construction of a reality that presents itself and needs to be capture in a constant process of mutation.

8. Acknowledgement

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Enhancing Disaster Preparedness through Participatory Activities in a School in Malaysia

Foong S Lam
Faculty of Engineering, Universiti Tunku Abdul Rahman
Kuala Lumpur, Malaysia

Yuk F Huang
Faculty of Engineering, Universiti Tunku Abdul Rahman
Kuala Lumpur, Malaysia

Abstract

Children are particularly vulnerable to the effects of natural disasters. The purpose of this study was to assess the effect of flood slide presentation and a child-friendly participatory approach using the HVCA (Hazard, Vulnerability and Capacity) Assessment adapted from Plan International Child-Centred Disaster Risk Reduction on students' preparedness for flood. This study used instruction on flood knowledge and preparedness coupled with participatory teaching sessions on DRR. Qualitative information was gathered using classroom observations and interviews. The findings indicated that school curriculum did not cover disaster awareness and these students in this study felt more prepared for flood after an intervention that consisted of flood knowledge and preparedness slide presentation and HVCA participatory sessions.

Background

Over the last 5 years in Malaysia, various natural disasters have occurred in our country such as floods, landslides and even the more recent earthquake. From 15 December 2014 to 3 January 2015, Malaysia has experienced from what is said to be the 'worst flood in decades'. The flood occurred mostly in the East Coast and northern region of Peninsular Malaysia such Kedah, Johor, Kelantan, Negeri Sembilan, Perlis, Perak, Pahang, Sabah and Sarawak. Over 200,000 of people has been evacuated from their homes, 21 killed and repair to damages is expected to sum up to RM560 million (Agence et al., 2014). Going back a few months ago, on 5 June 2015, a 6.0 moment magnitude earthquake had struck Ranau, Sabah, which is the strongest earthquake Malaysia has ever faced since 1976. The earthquake has resulted in damages to buildings and infrastructure along with geological changes and landslides. About 137 climbers were left stranded with 18 deaths. Hence, it is imperative that youths of today should be empowered through education with the knowledge to be able to cope with these adverse effects of natural disasters. This is necessary in order to lower the youth's vulnerability and improve their resiliency during these events. Education has an important role to play to brace a community for incoming disasters. Through education, people will be well-versed in what to expect when a disaster strikes, how to prepare, what to do and how to cope in such situations (De Lavega, 2004).

In Malaysia, we tend to have mindset of 'taking action only after something bad has happened'. Other than that, most of us have been living under the assumption that disaster will never occur around the area that we live. Disaster reduction risk (DRR) knowledge is not integrated in Earth Sciences, Environmental Sciences or Geography syllabuses in Malaysian schools although there are many initiatives by the government, research institutes and non-governmental agencies such as Mercy Malaysia to promote DRR through education. DRR and emergency-related drills are conducted as extra-curricular activities that involve the participation of the Boy Scouts, police, fire brigade and school officials. In 2008, the Ministry of Education formally developed policies on School Emergency Preparedness and Response Programs. In 2010, The Emergency Preparedness Handbook was distributed to 5.4 million school children. In the same year, the Smart Support Team (SST) was deployed. The SST is a formal support group who seek to meet the educational and psychological needs of children who were traumatized by disasters. The mandate to expand these programs to respond to disasters was given to the National Security Council, Department of Social Welfare, Malaysian Red Crescent and the Malaysian Medical Relief Society (MERCY Malaysia). In the same year, SST leaders from the districts were trained together with 400 volunteers on Basic Mission Training (BMT) by MERCY Malaysia to prepare them for humanitarian relief missions (Wan, 2007).

Low risk perception and low level of disaster awareness and preparedness knowledge increase communities' vulnerability to natural hazards especially for communities living in remote areas who do not have easy access to transportation and communication. Habibah (2012) used videos on landslides to educate teachers in one of the indigenous (*orang asli*) public schools in Perak, Malaysia. The findings revealed videos and televisions are good
DRR educational tools and reported that the teachers has little knowledge on how landslide occurs and recommended that teachers find most effective ways to educate their students on landslides and safety. However, this study was limited to only one *orang asli* public school therefore further research on better approach to reach more participants in educating communities and school children in remote areas is needed. While research indicates that DRR education is important for students and teachers but there is little research carried out about what type of educational materials and tools would be most effective for various demographic groups (Duong, 2009).

Children are considered one of the most treasured classes during a disaster (Twigg, 2004). Factor such as their age affects their overall vulnerability and shapes their ability and capability to cope and survive in a disastrous environment. School children are an important part of the overall community disaster awareness and preparedness process. These students are future decision makers, who may encounter a significant disaster event in their lifetime, and they need be educated on how to prepare for disaster. Educational intervention among school children may help increase awareness and preparedness of parents and subsequently the local community (Gulay, 2010).

In the Camotes Islands of Indonesia, the children cooperated to recover degraded mangrove ecosystems by bringing together teams to assemble and replant tree saplings in sanctuaries through the installation of

protective barriers. The participation of these children has captivated community members and thrived in marshalling constituencies to provide the greater protection of their ecosystem.

DRR educational lessons seem to be most effective when children engage in hands-on, experiential learning. For example, school children in Andhra Pradesh, India, which is periodically affected by severe cyclones, learn how to treat injuries by bandaging fake wounds and rescue their friends from the beach in disaster drills. Some children in Sri Lanka participate in a school mapping exercise to identify safe evacuation routes. (Nikku et al. 2008). After several hurricanes and earthquakes struck El Salvador, Plan International encouraged the establishment of children's DRR clubs to learn about DRR risks and to protect their friends when disaster strikes. In Jamaica, schools children participated in cooking competition that used only food that would be available after a disaster (Peek, 2008).

Purpose of the study

Findings from previous study (Mitchel et. al, 2008) demonstrate a need for children participation in disaster risk reduction. Research on children in emergencies is lacking in Malaysia and their potential value on working with children in reducing disaster risk and helping to shape DRR planning has been overlooked by researchers and policy makers in Malaysia. This paper aimed to examine the level of disaster preparedness to assess the effect of flood slide presentation and a child-friendly participatory approach using the HVCA (Hazard, Vulnerability and Capacity) Assessment adapted from Plan International Child-Centred Disaster Risk Reduction on students' preparedness for flood.

Methodology

The instructional sessions of the intervention started with flood content slide presentation contained animations, illustrations, images and maps to teach basic flood knowledge, to explain the flood phenomenon occurring globally and in Malaysia, why it is important to prepare for flood and how to prepare for flood disaster. A hydrology researcher who is also a lecturer from the Department of Civil Engineering at UTAR visited the students to conduct the slide presentation. The presentation lasted for 40 minutes. Qualitative data that were collected as part of the study were open-ended question responses, classroom observation notes and interviews.

In addition to slide presentation of flood content knowledge, a child-friendly participatory approach using the HVCA (Hazard, Vulnerability and Capacity) Assessment adapted from Plan International Child-Centred Disaster Risk Reduction was adopted. HVCA is an analysis that uses various participatory tools in an effort to better understand the level of people's vulnerability along with capacity to combat natural hazards at the grass-roots level. Thus, it is an essential part of disaster preparedness and can add to the creation of community-based disaster preparedness programmes at the rural and urban areas. Children were guided by a set of questions for discussion to introduce student the concept of hazard, identify vulnerability, capacity, and risk in their communities as part of the implementation of this child-led DRR project. The

research was conducted through risk mapping, small group scenario discussion and brainstorming sessions with participants of 30 school students from Sekolah Agama Darun Naim, Kuala Krau. Each student group representatives were appointed to share their experiences, insights and recommendations. Sessions were recorded through notes.

The Malaysia Civil Defence Department, or also known as Jabatan Pertahanan Awam Malaysia (JPAM) has provided an excellent user-friendly disaster preparedness pamphlet which outlined household stockpile checklist, emergency contact numbers, disaster response actions and survival tips were distributed to the students as educational materials

Figure 2: The school we visited

Figure 3: A chair on the roof of a classroom which served indicator of the flood level during the recent flood

Figure 4: *Ceiling fans that were damaged during the flood*

Results and Discussion

Slide presentation of flood knowledge

The students that were interviewed said that no disaster prepearedness awareness programme/activities have been carried out after the 2014 flood that hit that area during and outside school time. Disaster education is not included in any subjects in the Malaysian school syllabus. Students demonstrated a great enthusiasm in learning new facts and information about flood and were eager to be intellectually engaged on the subject during the slide presentation. From interview and classroom observations, the presentation

increased flood preparedness and help them strengthen flood knowledge. During the interview, students expressed their gratitude for learning new knowledge about flood and dangers related to it from the slide presentation and a heightened sense of anxieties in students as they are now more informed about the dangers of floods and better prepared for them.

Figure 5: *Part of the contents of slide presentation*

Figure 6: *Students who participated in the intervention*

Figure 8: *Lecturers with student helpers and members from Tzu Chi Association* who helped us

HVCA child-led activities

3.1 Body Map

This activity was the first activity conducted in the school. The purpose of this activity is to help the students to process their feelings after disaster. At the start of this activity, the students were divided to male and female groups specifically. The groups were given large flip chart papers and marker pens for the activity. A silhouette of a student were drawn on the single piece of paper. From there, the body map and body parts drawn were used to analyze and document the students' perspectives based on their own individual experience during the flood. Main questions related to the activity included:

- Head: How has the disaster influenced the way they think?
- Eyes: What have they observed or seen throughout the disaster period?
- Ears: What have heard during the disaster period? How has it affected the way people their age listen to adults?
- Mouth: How has the disaster affected the communication among people? Or the way adult communicate with younger ones and vice versa?
- Main body: How has the disaster affected their health?
- Heart: What emotions have they experienced during the disaster? Has it affected their feelings toward other people?
- Arms and hands: What activity have they been involved in during the disaster?
- Legs and feet: What changes are there in places where people in general can or cannot go?

The students were encouraged to write or draw out their answers on the flip-chart papers given. From discussions with the students during body map activity, there were no signs of distressed in the students 2 years after disaster. Further studies are recommended for comprehensive assessment of emotional problems as well as the identification of risk and related coping mechanism of children and their families immediately after disaster. With more research data available about the effects of natural disasters on children, whether girls experienced more emotional distress than boys and how friends and family help children cope after disaster, there is greater hope that children's level of preparedness can be improved and their voice be heard in DRR planning (Masten et al., 2012).

Figure 9: Instructions given to a group for body map

Figure 10: Student groups discussing about body map

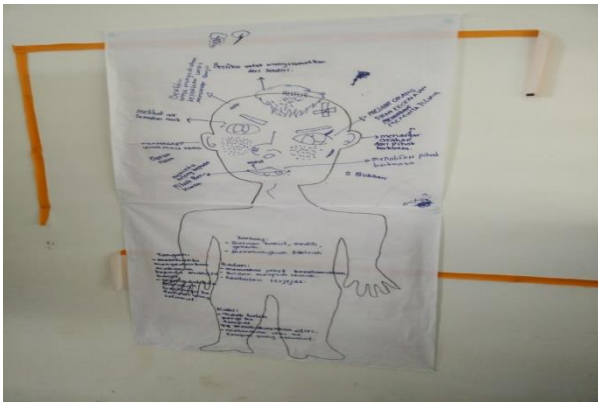

Figure 11: End result of one of the body maps

3.2 Community Map

In this group activity students were required to draw out a map of their community based on their own perspectives. Important landmarks and locations such as residential areas, hospitals, schools and government buildings etc were identified. Through this community map, the students were taught on defining and identifying vulnerability, capacity, risk and risk reduction.

Each group of students were given large flip-chart papers and markers. One student in the group was tasked to draw the map on the flip-chart paper with the indication of the north direction. Another student was asked to identify and draw roads, landmarks, buildings, etc. The third student from the group identified and drew out the government buildings within the community and schools. The fourth student were given task to add more contexts to the community map such as rivers, roads, crop fields, public facilities, etc.

After the community map has been drawn, each group were assigned to identify and list out the vulnerability and risk that can be found within the map. From there, the students discussed and brainstorm on how they can minimize and/or mitigate the risk along with how they can convert the vulnerabilities identified into capacities.

Majority of the participants did not know the main hazards and vulnerabilities that their community and

family members face and do not have a DRR plan. This suggests that DRR preparedness among the students is very low.

The child-led programme activities seemed to generate higher level of engagement among the students compared to slide presentation on flood and preparedness knowledge. DRR educational lessons seem to be most effective when children engage in hands-on, experiential learning. (Plan-UK, 2002). The observations from this study further highlight that active participation on DRR is more effective for understanding risk and capacity to undertake preparedness actions. The children participated in these activities gave encouraging feedback about the activities. They felt they are less fearful of flooding because they were aware flood risk and knew how to better protect themselves better after the interventions.

Figure 12: *Another lecturer explaining to students about vulnerabilities.*

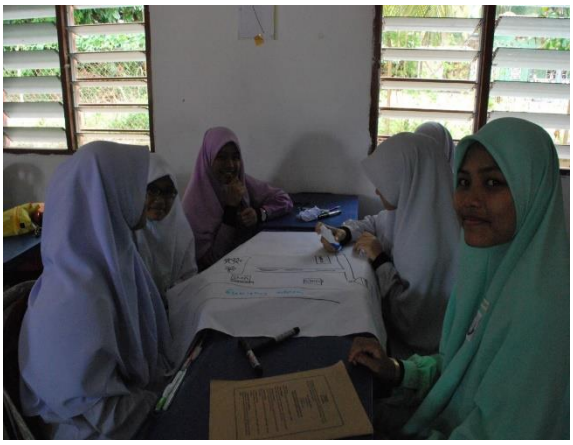

Figure 13: *One of the group's illustration of what flood looked like in their community.*

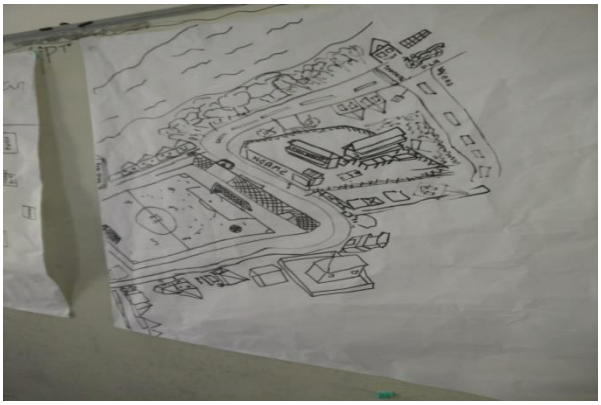

Figure 14: *Students drew a community map and identified vulnerabilities and capacities in their map*

Figure 15: *Community map drawn by one of groups*

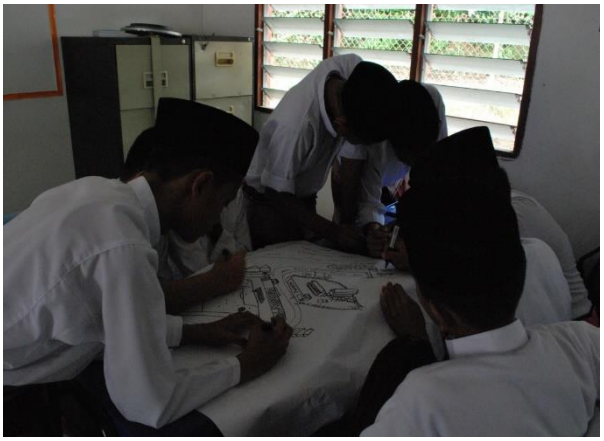

Figure 16: Groups of students constructing their community map

Conclusion

The project conducted in a school in Kuala Krai, Pahang proved that instructional intervention such as slide presentation and child-led HVCA can serve as a tool for students to appraise disaster risk in their local environment because it provides a tangible view of vulnerabilities and capacities in the facing flood hazard. Students gave positive remarks stating it increased their knowledge about flood disaster and risk reduction. Community mapping facilitates dialogue between children and adults and children who are usually excluded in from policy planning yet possess the capacity to assist in the construction of DRR planning.

Qualitative findings of the study in general demonstrate an increase in awareness of flood knowledge among the students after the interventions. In addition, the findings also indicate that the students generally feel better prepared for flood after exposure to safe behavior through the presentations and HVCA activities. The findings showed that after the interventions students were equipped with basic knowledge about the causes of flood, what happens when flood occurs, and how to be prepared for and respond during flood. By increasing the awareness and preparedness, the interventions can be said to reduce the vulnerability of the students.

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Group Obedience and Its Impact on Academic Counseling Among Students: A Comparative Study of Boys and Girls in Public Secondary Schools in Tharaka- Nithi County, Kenya

Elosy Nyambura Riungu
Susan Muthoni Kinyua
Chuka University,
Department of Education,
P.o. Box 109- 60400,
Chuka, Kenya.

Abstract

This study sought to establish the impact of group obedience on academic counseling by comparing boys and girls in public secondary schools in Tharaka- Nithi County, Kenya. Causal- comparative research design was employed in this study. The accessible population was 9,419 form three students from public secondary schools in the county. A total of 12 schools were sampled using stratified sampling technique while random sampling was used to select 29 student respondents from each of the sampled schools. A sample of 348 respondents was involved in this study. Data was collected through a students' questionnaire. Validity of the instrument was ensured through judgments of research experts and scholars in the related area of study. Reliability of the instrument was estimated through a pilot study and the minimum threshold for reliability of the instrument was set at alpha 0.7. A reliability coefficient of 0.81 was got from the students' questionnaire. Descriptive statistics of frequencies and percentages were used to analyze data, while inferential statistics of a t- test was used to test the hypothesis. Hypothesis was tested at a significant level of alpha 0.05. Data analysis was aided by Statistical Package for Social Sciences (SPSS) version 21 for windows. A summary was used to organize qualitative data. It is recommended that teacher counselors intensify academic counseling programs by organizing sessions for various groups among students regardless of gender on how group obedience impacts on academic counseling.

Key words: Group obedience, Academic Counseling, Gender

Introduction

Academic counseling is one of the major services that secondary school students require in their pursuit for academic excellence since students often make misinformed decisions on how to handle challenges in schoolwork. This form of counseling is successful when teacher counselors hold face- to- face appointments with students (Hattie, 2009). Problems such as mental health issues, inappropriate study skills, poor time management and learning difficulties demand students to seek academic counseling (Sikolia &Lutomia, 2002). According to Schimidt (2003), students place more importance on the

supportive and caring nature of their relationship with their counselors than on the particular approach to counseling. Thus, participation in academic counseling increase students' satisfaction and mitigate students' feelings of isolation or disconnection from the institutions as a whole (Pandey, 2005). As a result, students may feel strengthened to pursue on their academic endeavors. A study by Wanjiru (2003) on assessment of organization and implementation of guidance and counseling programs in secondary schools showed that poor utilization of academic counseling in learning institutions led to students' academic problems going unaddressed and therefore negatively affecting academic performance. Another study by Silbert and Lake (2012) on peer assisted learning in teaching clinical examination to junior medical students revealed that males had lower extents of discussing academic issues with teacher counselors than females.

Human beings have been shown to be obedient in the presence of perceived legitimate authority figures (Burger, Girgis & Manning, 2011). Such authorities include orders by police officers, decisions by judges, directives by corporate executives and exhortations by clergymen. Authority figures exercise power only by virtue of the role that they occupy in a social group (Huffman, 2002). For instance, authority figures in students' groups are the group leaders who may command group members to seek or not seek academic counseling. In exercising authority, an authority figure invokes a norm and thereby obliges the targets to comply (Macionis, 2005). The greater the number of persons the authority figure can directly or indirectly influence, in this manner, and the wider the range of behaviors over which the authority figure has jurisdiction, the greater their authority within the group (Stark, 2004). A field study by Geffner and Gross in 1984 on sex- role behavior and obedience to authority investigated obedience by males and females (Tischler, 2004). The findings of the study revealed that more females than males fell victim of obedience. Thus, it is likely for male students to obey their group leaders at a lower extent than females in seeking or not seeking academic counseling. Group obedience to authority frequently produces beneficial results, for it facilitates coordination among persons in groups or collective settings (Wingfield, 2003). Yet if obedience to authority is questing, it can sometimes produce disquieting or undesirable outcomes (Wade & Tavris, 2005). In some cases, group obedience to authority can produce very negative consequences especially if the orders involve actions that are questionable or reprehensible (Schaefer, 2002). Group obedience among students may produce negative consequences like lack of academic improvement if group leaders command members not to seek academic counseling.

According to Colman (2009), some system of authority is a requirement of all communal living, and it is only the person dwelling in isolation who is not forced to respond, through defiance or submission to the commands of others. Therefore, it is inevitable for group members among students to be led by group leaders and thereby obey these leaders. The group leaders demand obedience to seek or not seek academic counseling from group members. Thus, the nature of group leadership determines whether students seek or do not seek academic counseling. Group obedience is further affected when participants are under direct surveillance by the person issuing orders; when participants are distant from rather than close to the victim and when participants are transmitters rather than expectants of a command (Macionis, 2005). Females obey with surveillance more than males whereas surveillance does not affect male's obedience (Sherif &

Sherif, 2003). One difficulty for women as they attempt to lead is that traditional leadership behaviors such as showing independence and exerting power over others conflict with the expected social roles for women (Lamberton & Kartz, 2012). According to Brown (2008), females are socialized in their societies to be more obedient and follow instructions than males. Hiral (2015) affirms that group obedience is higher in females than males due to the social roles into which females are expected to obey their husbands. Therefore, group obedience towards academic counseling may be shown more to male than female group leaders. This outcome could have certain impact on students' acts of seeking or not seeking academic counseling.

Objective

The objective of this study was to establish the impact of group obedience on academic counseling by comparing boys and girls in public secondary schools in Tharaka- Nithi County, Kenya.

Research Methodology

This study was a descriptive research which employed causal- comparative research design. This research design was appropriate for this study because two groups; that is, boys and girls were used to bring out a comparison on the impact that group obedience has on academic counseling. This study was carried out in Tharaka- Nithi County, Kenya. The population of the study was drawn from an accessible population of 9,419 form three students from public secondary schools in Tharaka- Nithi County (County Education Officer (CEO), Tharaka- Nithi County, 2015). The sample size of this study was 348 respondents which comprised of 174 boys and 174 girls. Stratified sampling procedure was used to sample 12 schools proportionately from the 142 public secondary schools according to sub- county categories. In addition, random sampling was applied to select 29 form three student respondents from each of the sampled schools.

The researcher used a students' questionnaire to collect the desired data for the study. The raw data gathered from the field was classified according to the categories of respondents and coded based on the objective of the study. To validate the instrument, the researcher sought expertise assistance from research experts and scholars in the related area of study. Reliability of the instrument was estimated through a pilot study. Internal consistency of the questionnaire was considered reliable if it yielded a minimum threshold reliability coefficient that was set at alpha 0.7 using Cronbach reliability coefficient. The coefficient for the questionnaire was 0.81. Descriptive statistics of frequencies and percentages were applied in analysis of data. Inferential statistics of a t- test was used to test the research hypothesis and the test on the hypothesis was done at a significant level of alpha 0.05. The analysis was aided by Statistical Package for Social Sciences (SPSS) version 21.0 for windows. Qualitative data from the open- ended question was organized into a summary. The researcher obtained a letter of introduction from Chuka University and then sought a research permit from the National Commission for Science Technology and Innovation (NACOSTI).

Results and Discussion

An item in the questionnaire sought to find out the age of respondents and the results are presented in Table 1.

Table 1
Distribution of Students by Age and Gender

Age	Boys		Girls	
	Frequency	Percentage	Frequency	Percentage
16 years and below	46	26.4	54	31.0
17 years	99	56.9	96	55.2
18 years	20	11.5	19	10.9
19 years and above	9	5.2	5	2.9
Total	174	100.0	174	100.0

The distribution in Table 1 depicts that majority of the students were 17 years old in both genders though higher in boys than girls. Students of 19 years and above were the lowest number although girls were less than boys; an implication that more boys may have been admitted to secondary school at an older age than girls.

Students were required to indicate the groups they belonged to by gender and the findings are presented in Table 2.

Table 2
Students' Groups by Gender

Group	Boys		Girls	
	Frequency	Percentage	Frequency	Percentage
Religious movement	8	4.6	12	6.9
Co- curricular team	86	49.4	82	47.1

Students' council	7	4.0	5
2.9			
Academic discussion	73	42.0	75
43.1			
Total	174	100.0	174
100.0			

The information in Table 2 indicates low representation of girls in the students' council probably because girls fear losing friends, who they value, once they become members of this group. This view is in line with Lamberton and Kartz (2012) who affirm that traditional leadership behaviors like exerting power over others conflict with the social roles of women. Religious movement had a lower number in males than females. The higher inclination of girls to religious movement is in line with Pew Research Centre (2016) which affirms that women are generally more religious than men, particularly among Christians. Students' council featured lastly with the lowest number of respondents among the four groups, with a lower percentage in females than males.

Information on group obedience and its impact on academic counseling were got from students' questionnaire. The findings on the impact of group obedience on academic counseling are presented in Table 3.

Table 3

Students' Position on Group Obedience and its Impact on Academic Counseling

	Girls			Boys	
Theme	N	Mean	SD	Mean	SD
Obey leader like group members do	174	2.57	1.4479	3.411	1.3112
Seek counseling against own will to please group leader	174	2.17	1.2450	3.36	1.3731
Obey leader in order to create harmony	174	2.60	1.3808	3.52	1.3631
Consult counselor only when leader commands	174	1.89	1.1756	2.66	1.4807
Like opinions of members to obey leader	174	2.04	1.1036	2.76	1.4818
Strictly adhere to leader's commands	174	2.44	1.4228	2.73	1.2968
Commend leader's commands	174	2.27	1.3618	2.45	1.5090
Fail to seek counseling since leader warns against seeking	174	1.94	1.0433	2.60	1.3804
Obey leader to avoid punishment	174	1.89	1.2692	2.77	1.3953

Obey leader's commands if members also do it	174	2.55	1.5112	3.55 1.2517
Valid N (Listwise)	174			

Results depicted in Table 3 on the impact of group obedience on academic counseling among boys and girls reveal the levels to which students obeyed their group leaders. Respondents were required to indicate the level to which they often agreed with what the group leader said about seeking or not seeking academic counseling. The students indicated the levels of their agreement about seeking academic counseling to please the group leaders. Findings from these items suggested a low and moderate impact of group obedience on academic counseling respectively in boys and girls. This higher trend in females to obey leaders more than males is in line with Brown (2008) who asserts that socialization of females in societies expects them to be more obedient and follow instructions than males.

Respondents indicated agreement on their strict adherence to group leaders' suggestions about seeking or not seeking academic counseling. An item required respondents to indicate their agreement on their failure to seek academic counseling because group leaders warned members against seeking this counseling service. Results from these two items revealed that group obedience caused low and moderate impact in boys and girls respectively. These views are supported by Hiral (2015) who declares that group obedience is higher in females than males due to the social roles into which females are expected obey their husbands. A t- test was done to establish differences in the impact of group obedience on academic counseling between boys and girls. This comparison is presented in Table 4.

Table 4

Summary of T- test Results on the Impact of Group Obedience on Academic Counseling

Category	Gender	N	Mean	SD	T- value	Df	P- value
Group obedience	Boys	174	2.38	0.4217	-3.834	346	0.855
	Girls	174	0.3790				3.06

The information in Table 4 indicates the results of the t- test done to establish differences in the impact of group obedience between boys and girls. The results reveal a p- value of 0.855 which indicated a value higher than the value at alpha 0.05 level of significance. Thus, the null hypothesis was accepted and it was concluded that there is no statistical significant difference in the impact of group obedience on academic counseling between boys and girls. These results are supported by Burger (2009) from a study he conducted on differences in group obedience between men and women which found no difference in obedience between both genders. It was concluded that both genders exhibit similar behavior, suggesting that group obedience occur independent of gender. However, a field study by Geffner and Gross in 1984 on sex- role

behavior and obedience to authority investigated group obedience by males and females and found out more females than males were victims of group obedience (Tischler, 2004).
There was insignificant difference between boys and girls in the manner they adhered to leaders' commands of seeking or not seeking academic counseling. Boys and girls obeyed their group leaders in equal measure because other group members did so in order to create harmony in their groups. These views are in line with a study on group obedience by Shanab and Yahya in 1978 who also found no difference in male and female obedience (Burger, Girgis & Manning, 2011). Boys' and girls' acts of obeying group leaders to avoid punishment brought out no difference in the impact of group obedience on academic counseling. These views are contradicted by Hofling who in the 1960s carried out a study on group obedience which found out females were more unwilling to question authority than males even when they had a reason to (Mc Leod, 2008).

General information about the influence of group leaders on members' attitude towards academic counseling was sought from an open- ended question in the students' questionnaire. The findings denoted that the leaders created desirable attitude towards academic counseling by encouraging members to seek academic counseling. Thus, group members sought academic counseling for academic improvement. Positive influence was also brought out from leaders by creating beliefs among group members that students required academic counseling for academic excellence. The findings revealed that group members tended to advise other members to seek academic counseling out of leaders' favorable influence towards academic counseling. These results are supported by Wingfield (2003) who affirms that group obedience to authority frequently produces beneficial results, for it facilitates coordination among persons in groups or collective settings.

Group leaders however influenced members negatively against academic counseling by criticizing this service. The leaders convinced members that they could handle their academic challenges without consulting the teacher counselor since they attached no value to academic counseling. This implied that students were unlikely to improve academic performance. Group members were directly discouraged from seeking academic counseling by group leaders. These views are in line with Schaefer (2002) who maintains that in some cases, group obedience to authority can produce very negative consequences especially if the orders involve actions that are questionable or reprehensible.

Conclusion and Recommendations

Group obedience which is geared towards seeking academic counseling causes academic improvement among students whereas obedience directed towards not seeking academic counseling limits this improvement. Male students obey group leaders on seeking or not seeking academic counseling to a lower extent than their female counterparts. Therefore, females benefit more from academic counseling than males and are likely to improve academic performance more than boys. Boys and girls desire similar attention in academic counseling since there is no statistical difference in the impact of group obedience on academic counseling between the two genders.

There is need for school administrators to institute school policies that boost group leaders' perception of academic programs offered in the schools. This may be achieved through having an open day with all group leaders in a school. Teacher counselors may need to intensify academic counseling programs by organizing sessions for various groups among students on how group obedience impacts on academic counseling.

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Influence of Professional Development Training on Headteachers' Financial Management Skills in Public Primary Schools in Kiambu County, Kenya

Onunga Dolly Anne
Jaramogi Oginga Odinga University
P.O Box 636-01000 Thika, Kenya

Corresponding Author: **Mr. Albert Onyango Akumba**

Abstract

Financial management skills of primary school headteachers has been established to contribute to performance of such schools. However, in Kiambu County, such success has not been registered despite the numerous professional development trainings school managers have undergone and still undergo. Thus, this study investigated influence of headteachers' professional development training on financial management skills in Kiambu County, Kenya. The study adopted mixed methods approach and thus apply explanatory sequential design. Questionnaires were used to collect data from headteachers and their deputies whereas interviews from staffing officer and sub-county director of education. Data analysis began by identifying common themes. The relevant information was broken into phrases. Qualitative data was analyzed thematically along the study objectives and presented in narrative forms whereas quantitative data was analyzed using descriptive statistics SPSS Version 23 and presented using tables and charts. The study established that training of headteachers can be conducted in different modes which include; on-job, off-job, just-in-time training, mentoring and networking. These forms of training models enhance headteachers's record-keeping, investment, pricing and costing and budgeting skills. Suitability of training materials enhances headteachers's record-keeping, investment, pricing and costing and budgeting skills. From the study findings, it is evident that the most important variable in such success is a well-prepared and capable trainer or facilitator. Evaluation of relevance of the training curriculum enhances headteachers's acquisition of record-keeping, investment, pricing and costing and budgeting skills. The study thus, recommends that training institutions should design and plan quality integrated training programmes to match headteachers work schedule. Training materials need to be specifically designed to suit the content of training programmes to enhance faster understanding of concepts to be learnt. In other words, the training material should be redesigned to also focus on acquisition of financial skills for effective investment and business management. Trainers' need to update their skills to match the changing times such as adopting use of ICT and attitude change towards headteachers empowerment. Training institutions and trainers need to plan for quarterly and semi-annual evaluation of training programmes since they are effective in ascertaining of the efficacy of such programmes.

Keywords: Financial management, professional advancement training, mode of training, trainers' characteristics, training evaluation and training content, headteachers.

Introduction

Financial management skills have a lot of benefits for primary school headteachers. Headteachers with a better grasp of the financial management skills proactively manage school finances. Keegam (2003) posits that headteachers' learned financial knowledge about financial management skills and accounting processes has been established to facilitate communication with financial specialists. Given such assertions, Armstrong (2001) indicates professional development training of primary school headteachers help them acquire pre-requisite skills to improve their understanding of different aspects of finance which are necessary for the success of any business venture. According to Thomas (2011), in the US, professional development training of primary school headteachers on financial management skills increase efficiency and competency in record keeping and overhead costing.

The evaluation of financial management skills is critically important in monitoring school record-keeping processes, pricing and costing and budgeting in a matter that meets the demands and needs of the education stakeholders (Thomas, 2011). Professional development training of primary school headteachers on financial management skills can essentially be thought of as a measure of the extent to which the headteachers have acquired pre-requisite skills for running the daily financial transactions of schools. In Singapore, Stoll, Bolam and Collarbone (2011) noted that, in order to realize change, strategic initiatives are required and such strategies need not lack support from school management, lack of high level commitment and direction that are important to the implementation of financial strategies which guarantee sustainability due to prudent financial management skills.

In other words, for any sane school organization to competitively deliver on its services and core values, financial professional development training of primary school headteachers and other stakeholders on efficiency, competency and effective time management is paramount for it will help minimize costs, enhance budgeting and improve on efficiency. In most countries in Sub-Saharan Africa, the scenario with professional development being considered as a critical aspect in financial management in primary schools (Mosha, 2004). For example, in Nigeria, Ayeni (2010) noted that headteachers' financial performance is evaluated annually to determine whether they have the potential for three different career paths after their three years' teaching, and three career paths respectively are master teacher, specialist in curriculum or research or school leader. Cognizant of these assertions, Bisschoff and Mestry (2003), noted that, amongst schools in KwaZulu Natal Province in South Africa, mode and duration of professional development training of headteachers determine the level of acquisition of knowledge acquisition on finance skills. Bisschoff and Mestry (2003) indicated regular, longer-period professional development trainings of primary school headteachers are effective in improving the ability of the managers to acquire financial skills necessary for financial management skills. These findings affirm the fact that longer duration and regular professional development training schedules enable curriculum content coverage and leaves the trainees satisfied. However, studies on duration and mode of professional development training and headteachers' acquisition of financial management skills need to be relooked since performance of most

schools in record-keeping, pricing, costing and budgeting has been on a downward trend as though unabated.

In keeping with these assertions, Van den Akker and Thijs (2002) assert that, in most primary schools in Tanzania and Uganda, professional development training content, materials and trainer characteristics are dynamics of staff professional development training which aid the acquisition of skills necessary to improve service amongst employees in public primary schools. In Kenya, professional development training of primary school managers on management of finance enable headteachers to obtain the record-keeping, pricing, costing and budgeting skills and also acquire expertise in basic accounting such as recording and reporting (Okumbe, 2007). In other words, there is need for primary school headteachers to make meaning of accounting strategies and procedures, developing financial statements and balance sheets, accounting journals which include; accounts receivables and payables, inventory, sales, purchases and payroll.

In Kiambu County, most primary schools have registered dismal financial performance despite the numerous professional development trainings primary school Headteachers have undergone in the past. According to the Ministry of Education (2015), most headteachers have been demoted due to financial misappropriation. Despite these findings, few studies have interrogated the contributions of mode of professional development training, duration of professional development training, trainers' characteristics and content coverage, hence the study.

Statement of the Problem

Professional development training of headteachers is known to contribute immensely towards the successful performance of most primary schools. However, despite the professional development training which most primary school managers have undergone, the financial performance of most schools is still below expectations. In Kenya, record-keeping, pricing, costing, budgeting and elementary accounting such as reporting is wanting amongst primary school headteachers (Economic Survey Report, 2014). Most primary schools in Kiambu County are no exception where financial prudence of primary school headteachers is wanting. Despite these observations, little has been done to interrogate the quality of professional development training which most headteachers undergo. On the same breath, most empirical studies have not been conceptualized to examine the mode of financial professional development training, professional development training content, trainer qualities and evaluation of the financial professional development training programmes, hence the need for his study.

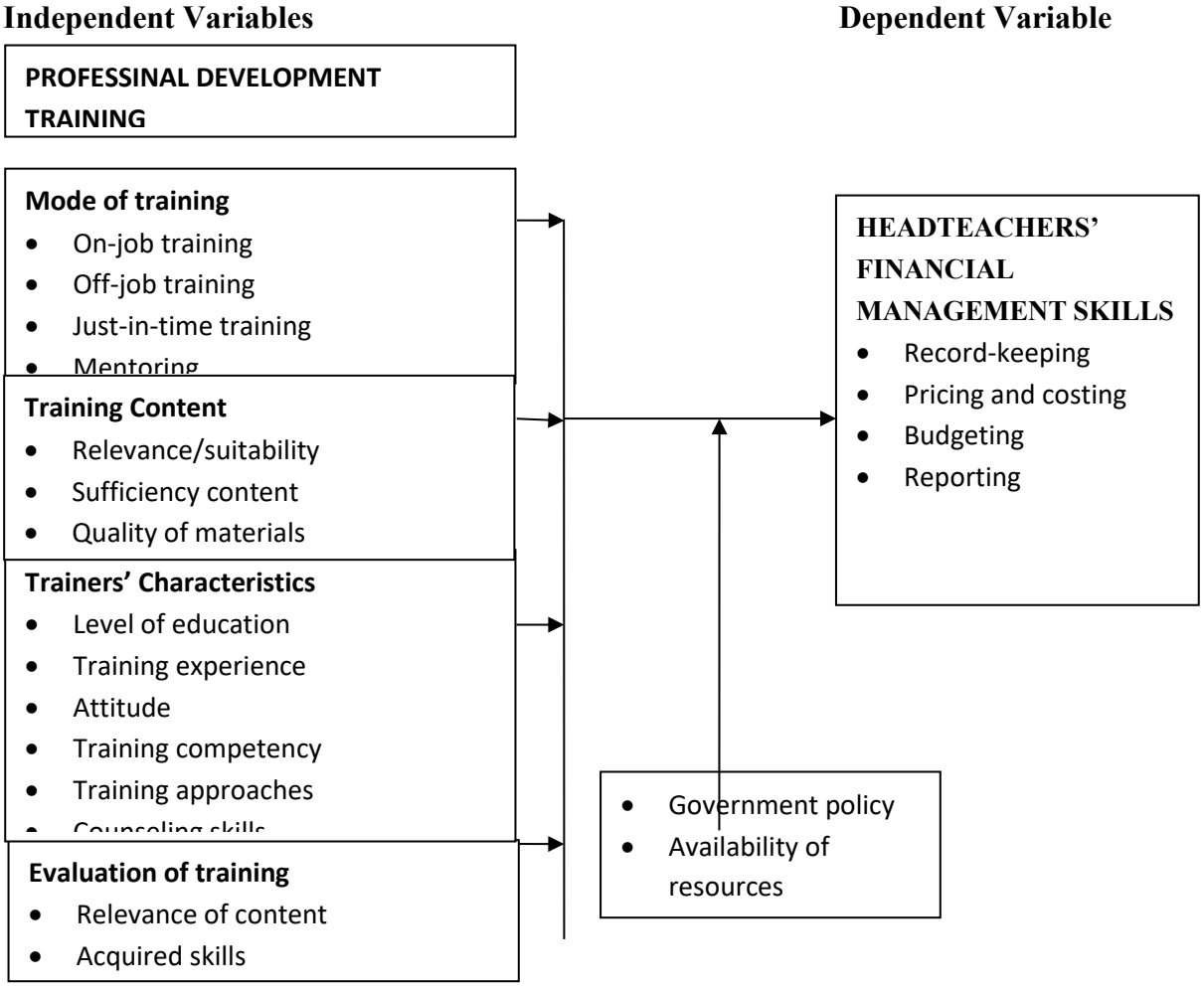
Theoretical Framework

The study was guided by the Professional Development Theory which was postulated by Krumboltz's (1979) and was grounded in social learning theory and in classical behaviorism. This theory specifically addresses the need for people to deal with change within the rapidly changing labor market. Krumboltz's theory offers insight on how to deal with the limited degree of control individuals have over some professional experiences. In this study, this theory offered a useful framework for describing and explaining

professional learning of headteachers. Krumboltz (1979) opened the doors of inquiry and the study of advanced professional training and thus established that there is a need to continue his study and to continue to support, design and implement curriculums tailored to the educational needs of the headteacher. This study was also guided by the financial agency theory which was postulated by Michael B. Adams (1994). This theory is extensively employed in the accounting literature to explain and predict the financial performance of institutions. The financial agency theory not only helps to explain and predict the existence of headteachers' financial, but also helps to explain the role and responsibilities assigned to headteachers by the schools. In the school context, the rationale of using this theory in this study was that it justified the fact that financial management skills have to be framed in the social and cultural context in which this branch of knowledge exercises a fundamental and credible role in the dissemination of school's financial information.

The Conceptual Framework

In this study, the conceptual framework was based on mode of headteachers' professional development training, professional development training content, and trainers' characteristics and evaluation of headteachers' professional development training which constituted independent variables. The dependent variable for this study were financial management skills. The intervening variables were government policy and availability of resources as shown in Figure 1;



Intervening Variables

Figure 1: The Conceptual Framework of the Present Study

Scope of the Study

This study was mainly concerned with financial training needs of headteachers, mode of professional development training, professional development training content, trainers' qualities and evaluation of professional development training programme as the independent variables. This study was conducted in Kiambu County. Data was only collected from primary school headteachers, deputy headteachers, staffing officers and zonal educational officers.

Research Methodology

The study applied mixed methods approach, that is, quantitative and qualitative methods. The study applied concurrent triangulation research design since this is a single-phase design in which the researcher applied quantitative and qualitative methods at the same time and with equal weight. Target population for this study comprised of 1045 headteachers, 1045 deputy headteachers, 12 staffing officers and 12 zonal education officers all totaling to 2114. Using the Central Limit Theorem, the researcher selected a sample of 248 respondents, that is, 11.7% of 2114. Stratified sampling was applied to create 12 strata based on the number of sub-counties in Kiambu County. From each sub-county, purposive sampling was used to select 10 headteachers and 10 deputy headteachers considering schools which have had cases of financial misappropriation. At the same time, purposive sampling was also applied to select the staffing officer and zonal education officers. This procedure enabled the researcher to obtain a sample size of 120 primary school headteachers, 120 deputy headteachers, four staffing officers and four zonal education officers. Data analysis began by identifying common themes from the respondents' description of their experiences. Qualitative data was analyzed thematically along the study objectives and presented in narrative forms whereas the quantitative data was analyzed descriptively with the help of Statistical Package for Social Science (SPSS 23) and quantitative findings presented using tables.

Results and Discussions

In this section, the data analysis, presentation and interpretation are reported. The following main questions guided the study:

i. To what extent do modes of headteachers' professional development training influence financial management skills in Kiambu County?
ii. How effective is professional development training content on Headteachers' financial management skills in Kiambu County?
iii. To what extent are trainers' qualities as a basis for enhancing Headteachers' financial management skills in Kiambu County?
iv. How does evaluation of professional development training programme influence headteachers' financial management skills in Kiambu County?

Respondents' Background Information

The questionnaires were administered to the headteachers and deputy headteachers. Out of the 240 questionnaires administered to the headteachers and deputy headteachers, 236 were successfully filled and returned. At the same time, four staffing officers and four zonal education officers were also interviewed. This also registered response rates as shown in Table 1:

Table 1: Response Rates

Respondents	Sampled Respondents	Those who Participated	Achieved Response Rates (%)
Headteachers	120	118	98.3
Deputy Headteachers	120	118	98.3
Staffing Officer	4	4	100.0
Zonal Education Officers	4	4	100.0
Total	**248**	**244**	**98.4%**

From Table 1, headteachers, deputy headteachers, staffing officers and zonal educational officers registered a response rate of 98.4%. According to Creswell (2009), a response rate above 75.0% is adequate and of suitable levels to allow for generalization of the outcomes to the target population.

Influence of Finance Training Models on Headteachers' Financial Skills

The study also collected data on the influence of finance training models on headteachers' acquisition of financial skills and results. Most of the headteachers respondents indicated that on-job training model has not effectively improved headteachers' financial skills. Headteachers noted that when trainers come to train at work places, there is no adequate time to learn different concepts in financial management. During the interview, one headteacher noted,

> *"It is always difficult for me to concentrate during training at my workplace. This is because, at my workplace, there are lots of duties to undertake which has made any training at my workplace not really helpful".*

This implies that holding any training at the headteachers' workplace poses a challenge since most headteachers are busy and cannot effectively participate in the on-job training. This further points to the fact that on-job training is not effective in enhancing headteachers' ability to acquire record-keeping, investment plans, pricing and costing projections, budgeting plans and e-financing skills. These findings were consistent with the assertions of Rothwell and Sredt (2012) who argued that training of headteachers in different self-help groups can be conducted on the job, which is carried out at the headteachers' workplace, and off-the-job which is carried out away from headteachers' work place.

Training methods include observing, questioning, interpreting, reviewing, coaching, e-learning, workshops, induction, job-shadowing, mentoring, seminars, classes, open learning, project work, workshop and simulation. When asked about the effectiveness of off-job training, majority of headteachers reported

that off-job training model is commonly adopted though has not improved their financial skills. During the interview, the headteachers indicated that off-job training offers them an opportunity to plan for the training sessions. An interview with a headteacher revealed,

> *"Most headteachers prefer off-job mode training since it accords them an opportunity to organize their time and schedule their daily programmes. It affords them the privilege of having time to be active and fully participate in the training process. They also have a moment to share their financial management challenges with their counterparts".*

However, most headteachers interviewees noted that off-job training has not actually translated into their ability to develop improved record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. This was attributed to the fact that most headteachers indicated that much time during off-job training is focused on allowing headteachers from different schools to bond together and share experiences on the challenges about their business ventures other than focus on how they should develop and acquire financial skills. These findings are consistent with the assertions of Rothwell and Sredt (2012) who argued that headteachers' training in different self-help groups can be conducted off-job which is carried out away from headteachers' workplaces.

Further majority of the headteachers respondents noted that most MFIs apply just-in-time training model though it has not effectively addressed headteachers' financial skills. Headteachers participants stated that just-in time training is quite preferable amongst headteachers since it raises the expectations of headteachers to receive money. This attests to the fact that just-time training has not been effective in enhancing headteachers' financial skills since many of the meetings rarely focus on financial skills content which enhance book keeping, pricing and costing projections, investments and budgeting skills. On mentorship, most of the headteachers respondents stated that mentorship exist but on a very low scale. During the interviews, one headteacher indicated,

> "*We have never seen any mentor being invited to advise us on matters about investments and prudent budgeting. None has come to share any information on the relevance of having a full mastery of financial skills such as book keeping, pricing and costing projections and investment"*

These views point to the fact that mentorship, though effective for training, has not been fully adopted to improve headteachers' financial skills. As headteachers claimed, mentors should have the ability to impart the relevant financial management skills as a tool for prudent utilization of any financial resources obtained from the government or donors. These findings were also supported by most of the staffing officers and the zonal education officers. These findings further corroborate the theoretical perspectives of Penrose (1959) that headteachers entrepreneurs with finance skills such as record-keeping, pricing and costing projections, investments and budgeting plans could easily make correct decisions and advise their colleagues concerning the financial transactions within their enterprises. These decisions invariably distinguish between a high performing and low performing enterprise. Moreover, it influences the vision, mission, culture, and values of headteachers-based enterprises.

These findings are in line with the assertions of Penrose (1959) who underscores the vitality of the level of headteachers' financial training which positively impact on their finance skills such as record-keeping, pricing and costing projections, investment plans, budgeting plans and e-financing. On exchange programmes and networking, 80.8% of the headteachers respondents stated that such programmes have never been rolled out to benefit headteachers. They stated that they rarely have opportunities to attend any form of training outside their locality. This implies that exchange programmes and networking are new approaches of training which majority of headteachers are yet to understand and experience their effectiveness in acquiring financial skills. These findings further point to the fact that most headteachers lack exposure to training programmes such as these which can enable them to gain much practical experience and acquire new initiatives and contributions which can improve the performance of the businesses.

During interviews, majority of the staffing officers who equally noted that training of headteachers at school has not been effective. However, these findings were disputed by the zonal education officers who noted that, despite their busy schedule, most training activities which occur at headteachers' places of work have been successful and effective. The zonal education officers noted,

> *"On-job training has been effective since it accords the trainer an opportunity to practically understand the challenges they undergo in their daily activities. Through this, headteachers are able to acquire financial skills and put them into immediate practice".*

Majority of the staffing officers who noted that, despite the preference of off-job training model, majority of headteachers still manifest poorly developed financial skills. On the same breath, the zonal education officers concurred with these views and noted that most headteachers prefer to undergo training during their meetings when all of them are available and have enough time to concentrate. Despite this, the officers confessed that most headteachers still manifest inability to keep financial records, do effective budgeting, pricing and cost projections and invest prudently into viable business ventures. During the interviews, staffing officers also expressed similar views with majority of them being in favor of the view that, despite its preference as a training model, headteachers have not been able to acquire financial skills. Zonal education officers were also in favor of the view that just-in time training is preferred though has not been effective in enhancing headteachers' financial skills.

These findings support the assertions of a study conducted in Jordan to establish the modes of training in which Bates and Khasawneh (2014) found that the just-in-time training methods allow headteachers to access the information on financial management which they need to enable them to exercise ownership over the learning process and immediately link learning to practical application. However, from the study findings, it is evident that, despite its preference as a training model, just-in time training model has not effectively enhanced headteachers' financial skills. On the same breath, a record majority of the staffing officers also corroborated the views expressed by headteachers. They noted that exchange programmes and networking are new models of training which most training institutions are yet to embrace.

Zonal education officers also admitted that training institutions have not embraced a scenario where headteachers are given an opportunity to attend training outside their places of work or meetings. This

further attest to the fact that exchange programmes and networking have not been effectively applied as a model to train headteachers on financial skills. These findings lend credence to the assertions of Blanchard and Thacker (2012) that implementing headteachers exchange programmes as a method of training and development has become gradually popular. In other words, by participating in the headteachers exchange training programmes, headteachers are able to share information from different localities. This method supports headteachers' development by giving them a chance to learn from different environments and the true meaning of this programme is training, sharing, earning and improving experience of the headteachers, both locally and internationally. Besides, the headteachers who gain much practical experience will come back with initiatives and contributions to improve their performance. Data was also collected from deputy headteachers and results are shown in Table 2:

Table 2: Findings of the Influence of Finance Training Models on Headteachers' Finance Skills

Summary of Test Items	SA %	A %	U %	D %	SD %
On-job training enhances headteachers' financial skills	71	12.3	1.3	10.1	5.3
Off-job training enhances headteachers' financial skills	66.9	13.2	2.4	12.7	4.8
Just-in-time training enhances headteachers' financial skills	80.5	12.4	1.6	3.3	2.2
Mentoring enhances headteachers' financial skills	67.4	19.7	3.5	5.3	4.1
Exchange programmes enhance headteachers' financial skills	69.6	13.8	1.6	10.6	4.4

Table 2 reveals that majority (71%) of the deputy headteachers strongly agreed with the view that on-job training enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. At the same time, 12.3% agreed. However, only a paltry 1.3% of the deputy headteachers were undecided, 10.1% disagreed whereas 5.3% strongly disagreed. Just like in qualitative findings, these findings also corroborate the assertions of Rothwell and Sredt (2000) who argued that training of headteachers in different self-help groups can be conducted on the job, which is carried out at the headteachers' workplace, and off-the-job which is carried out away from headteachers' work place. Training methods include observing, questioning, interpreting, reviewing, coaching, e-learning, workshops, induction, job-shadowing, mentoring, seminars, classes, open learning, project work, workshop and simulation.

The study also revealed that a fair majority (66.9%) of the deputy headteachers strongly agreed with the view that off-job training enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 13.2% of the deputy headteachers. At the same time, 2.4% of the deputy headteachers were undecided, 12.7% disagreed whereas 4.8% strongly disagreed. The study also revealed that an impressive majority (80.5%) of the deputy headteachers strongly agreed with the view that just-in-time training enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 12.4% of the deputy headteachers.

However, 1.6% of the deputy headteachers were undecided, 3.3% disagreed whereas 2.2% strongly disagreed. These findings are also consistent with the findings of a study conducted in Jordan to establish the modes of training in which Bates and Khasawneh (2005) found that the just-in-time training methods allow headteachers to access the information on financial management which they need to enable them to exercise ownership over the learning process and immediately tie learning to practical application. A fair majority (67.4%) of the deputy headteachers strongly agreed with the view that mentoring enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. 19.7% agreed. However, 3.5% of the deputy headteachers were undecided, 5.3% disagreed whereas 4.1% strongly disagreed.

The study also revealed that a fair majority (69.6%) of the deputy headteachers strongly agreed with the view that exchange programmes enhance headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 13.8% of the deputy headteachers. On the other hand, 1.6% of the deputy headteachers were undecided, 10.6% disagreed whereas 4.4% strongly disagreed. These findings further lend credence to the assertions of Blanchard and Thacker (2000) that implementing headteachers exchange programmes as a method of training and development has become gradually popular. In other words, by participating in the headteachers exchange training programmes, headteachers are able to share information from different localities.

These findings were also consistent with the findings of a study conducted in Bangladeshi in which Katz and Kahn (2000) revealed that headteachers in different self-help groups were found to have shared information with those from Vietnam. This method supports headteachers' development by giving them a chance to learn from different environments and the true meaning of this programme is training, sharing, earning and improving experience of the headteachers, both locally and internationally. Besides, the headteachers who gain much practical experience will come back with initiatives and contributions to improve their self-help group's process and performance.

Finance Training Content and Headteachers' Finance Skills

The study sought to find out how finance training content and materials impact on headteachers' finance skills. Most of the headteachers stated that content of finance training materials is not suitable to enhance their acquisition of financial skills.

Headteachers stated that materials for training provided by training institutions contain information which are not suitable for enhancing financial skills. At the same time, most of headteachers also noted that finance training materials only have content on loaning processes and interests thus irrelevant to promote headteachers' acquisition of financial skills. Majority of the headteachers respondents also reported that most Training institutions do not provide headteachers trainees with adequate training materials. During the interviews, one headteacher noted,

> *"The training materials are rarely relevant nor are they sufficient. They only contain information on voted heads and budget preparation and no other financial management skills"*

These findings corroborate the assertions of Daffron and North (2010) that training materials must be selected carefully to ensure that they are appropriate for the training group and that they contain aspects of financial skills such as planning, pricing and costing, record-keeping, control, investment and expenditure, budgeting and working capital management. When asked about the effectiveness of language used in the training materials, many headteachers respondents noted that language used in most finance training materials is complex for headteachers to understand. During the interviews, one headteacher reported,

> *"I always find it difficult to understand the contents of training materials provided by training institutions since the language used in very technical and subjective. That is, the individual who is able to understand must have basic knowledge in accounts and interpretations confusing".*

However, the zonal education officers refuted the claims that training materials provided by the training institutions are not suitable, not relevant nor ar they adequate. Majority of the staffing officers, however, concurred with the headteachers that language used in developing most of training materials is quite complex and technical for headteachers to understand. These views were also supported by zonal education officers who also indicated that sometimes headteachers require serious explanations for them to make meaning of the language used while developing the training materials. These findings support the assertions of a study conducted in Bangladesh by Armstrong (2012) which revealed that training materials, which are carefully chosen or prepared can communicate concepts and ideas better than words. Data was also collected from deputy headteachers and the results are shown in Table 3;

Table 3: Findings of the Influence of Training Materials on Headteachers' Finance Skills

Summary of Test Items	SA %	A %	U %	D %	SD %
Suitability of training materials enhances headteachers' financial skills	55.9	15.1	2.8	16.8	9.4
Relevance of training curriculum content enhances headteachers' financing skills	59.1	23.5	2.7	5.9	8.8
Sufficiency of training materials enhances headteachers' financial skills	58.9	17.2	2.0	19.3	2.6
Quality of training materials enhances headteachers' financial skills	78.4	11.1	2.1	3.9	4.5
Guidance and counseling of headteachers loanees enhance their financial skills	80.3	9.1	3.6	4.1	2.9

Table 3 reveals that slightly more than half (55.9%) of the deputy headteachers strongly agreed with the view that suitability of training materials enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. At the same time, 15.1% agreed. On the contrary, only a small proportion of 2.8% of the sampled deputy headteachers were undecided, 16.8%

disagreed whereas 9.4% strongly disagreed. Like in qualitative views, these quantitative findings further corroborate the assertions of Daffron and North (2006) that training materials must be selected carefully to ensure that they are appropriate for the training group and that they contain aspects of financial skills such as planning, pricing and costing, record-keeping, control, investment and expenditure, budgeting and working capital management.

Implementation should create more coherence across the various training opportunities available to staff in public institutions, while also acknowledging the diversity of settings. The study also revealed that slightly more than half (59.1%) of the sampled deputy headteachers strongly agreed with the view that relevance of training curriculum content enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 23.5% of the deputy headteachers. However, 2.7% of the deputy headteachers were undecided, 5.9% disagreed whereas 8.8% strongly disagreed. Similarly, slightly more than half (58.9%) of the deputy headteachers strongly agreed with the view that sufficiency of training materials enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 17.2% of the deputy headteachers.

However, 2.0% of the sampled deputy headteachers were undecided, 19.3% disagreed whereas 2.6% strongly disagreed. These findings support the findings of a study conducted in Austria in which Schwoerer et al (2005) noted that training materials with enough content register cases of improved performance. Schwoerer et al (2005) further assert that these resources, when well applied, can lead to prudent management of finances by headteachers. On the contrary, a record majority (78.4%) of the deputy headteachers strongly agreed with the view that quality of training materials enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 11.1% of the deputy headteachers. However, 2.1% of the deputy headteachers were undecided, 3.9% disagreed whereas 4.5% strongly disagreed.

An impressive majority (80.3%) of the deputy headteachers strongly agreed with the view that guidance and counseling of headteachers loanees enhance record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. At the same time, 9.1% were also in agreement. However, 3.6% of the deputy headteachers were undecided, 4.1% disagreed whereas 2.9% strongly disagreed. These findings lend credence to the assertions that effective use of curriculum and content materials on finance during training have been found to contribute to headteachers' acquisition of finance skills.

Finance Trainers' Characteristics and Headteachers' Financial Skills

The study also sought to establish how finance trainers' characteristics influence headteachers' finance skills. During the interviews, most of the headteachers respondents stated that education of finance trainers does not determine the ability of headteachers to acquire financial skills. When probed further, a headteacher respondent observed,

> *"I may not know the level of education of my trainers, but I am only concerned with the ability of the trainer to make me understand different concepts in financial skills".*

However, few staffing officers responded in favor of the view that trainers' educational level does not determine headteachers' acquisition of financial skills. During the interview, a staffing officer remarked,

> *"For effective delivery of training content, the trainer must have good educational background. Education enables the trainer have a grasp of the concepts being taught".*

These findings lend credence to the assertions of a study conducted in the Nicaragua amongst 211 respondents to establish the efficacy of professionals on headteachers training and financial management in which Michael and Dwivedi (2013) have shown that the most important variable in such success is a well-prepared and capable trainer or facilitator. Likewise, these views attest to the fact that trained professionals such as trainers and other stakeholders have been identified as a principal factor which contributes to headteachers's acquisition of pre-requisite skills to manage their enterprises. When asked whether training institutions hire experienced trainers, most of the headteachers respondents reported that training institutions usually hire experienced trainers, though has not improved financial skills amongst headteachers. During the interviews, one headteacher observed,

> "*Trainers hired by training institutions often have a wealth of experience in training clients for the Training institutions. Despite this, I still have challenges with my record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills".*

These findings lend credence to the assertions of Nwoye (2011) who noted that, with the majority of headteachers spending large portions of their working days in general education or training settings, trainers must be knowledgeable of the headteachers' core characteristics, relevant evidence-based training strategies as well as general strategies for training headteachers in different cadres or levels of education to ensure that headteachers succeed in realizing their full entrepreneurial potential. On trainers' attitudes, majority of the headteachers respondents noted that most finance trainers view headteachers as people who cannot acquire financial skills. Headteachers noted the society views their inability to manifest any for financial skills as appropriate. During the interviews, one headteacher noted,

> "*My ability to acquire financial skills has been made difficult by people's attitude. For example, our trainers view us as people with little understanding of financial concepts, lazy, not hardworking and that only men have the capability of undergoing complex financial training".*

These views point to the fact that attitude and biases which trainers hold against headteachers is a hindrance to the headteachers' ability to master financial skills. Besides, this points to the fact that gender stereotyping developed by trainers has a way of preventing headteachers from actively taking part in finance training. These views were echoed by most of the staffing officers who indicated that any trainer who manifests any form of gender bias towards headteachers is an obstacle to the headteachers' acquisition of financial skills. However, the zonal education officers of the deputy headteachers disagreed with the view that most of the trainers consider headteachers as people who cannot acquire financial skills. These further corroborate the views expressed by Michael and Dwivedi (2013) that beliefs the professionals have about headteachers'

ability to manage finances and their understanding of the challenges bedeviling headteachers after borrowing finance from training institutions, hold key to the success of such training. During the interviews, most of the headteachers also reported that finance trainers rarely possess guidance skills to enhance their ability to impart financial skills to headteachers. Headteachers stated that trainers do not show any care and concern for the financial challenges. One headteacher reported,

> *"When I share a challenge with my trainer, he does not appear to care about seeking for a solution. Sometimes, it is even difficult to ask the trainer any question about a topic learnt since he answers rudely and never provides any convincing answer. He often blames me for inattentiveness during training sessions".*

These findings affirm the fact that guidance and counseling skills play an important role in training and any trainer should have such skills. Any trainer with guidance and counseling skills have their trainees manifest impressive acquisition of financial skills. This further implies that trainer with effective counseling skill shave the ability to understand group dynamic which a hindrance to the headteachers' acquisition of financial skills might be. Staffing officers also echoed similar sentiments with majority indicating that any trainer with effective guidance and counseling skills have the ability to help headteachers to manage challenges of self-rejection, low self-esteem and faulty self-concepts. Zonal education officers also concurred. These findings thus lend credence to the views expressed by Nwoye (2011) and Kehrhahn (2012) that have had difficulty identifying specific training and counseling skills or approaches of training which professionals should adopt to improve their effectiveness in enhancing headteachers's acquisition of important skills to undertake finance management. Thus, these views also attest to the fact that professional training of trainers and stakeholders predict management of finances among headteachers. Data was also collected from deputy headteachers and results are shown in Table 4;

Table 4: Findings of the Influence of Finance Trainers' Characteristics on Headteachers' Finance Skills

Summary of Test Items	SA %	A %	U %	D %	SD %
Trainers' level of education enhances headteachers' financial skills	69.2	14.1	1.3	10.1	5.3
Trainers' experience enhances headteachers' financial skills	66.9	13.2	2.4	12.7	4.8
Trainers' attitude and cultural orientation enhance headteachers' financial skills	80.5	12.4	1.6	3.3	2.2
Trainers' counseling skills enhances headteachers' financial skills	67.4	19.7	3.5	5.3	4.1
Trainers' ability to integrate ICT enhances headteachers' financial skills	69.6	13.8	1.6	10.6	4.4

Table 4 reveals that majority (69.2%) of the deputy headteachers strongly agreed with the view that trainers' level of education enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. At the same time, 14.1% agreed. However, only a paltry 1.3% of the sampled deputy headteachers were undecided, 10.1% disagreed whereas 5.3% strongly disagreed. Like qualitative views, these findings also corroborate the findings of a study conducted in the Nicaragua amongst 211 respondents to establish the efficacy of professionals on headteachers training and financial management in which Michael and Dwivedi (2003) have shown that the most important variable in such success is a well-prepared and capable trainer or facilitator. Hence, these findings affirm the fact that trained professionals such as trainers and other stakeholders have been identified as a principal factor which contributes to headteachers's acquisition of pre-requisite skills to manage their enterprises.

The study also revealed that a fair majority (66.9%) of the sampled deputy headteachers strongly agreed with the view that trainers' experience enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 13.2% of the deputy headteachers. At the same time, 2.4% of the deputy headteachers were undecided, 12.7% disagreed whereas 4.8% strongly disagreed. These findings are consistent with the assertions of Nwoye (2011) that the best practice for trainers suggests that trainers should become well versed and trained in evidence-based instruction and behavioral techniques in order to help the headteachers obtain his or her therapeutic and training goals. The study also revealed that an impressive majority (80.5%) of the sampled Deputy headteachers strongly agreed with the view that trainers' attitude and cultural orientation enhance headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 12.4% of the deputy headteachers. However, 1.6% of the sampled deputy headteachers were undecided, 3.3% disagreed whereas 2.2% strongly disagreed. A fair majority (67.4%) of the deputy headteachers strongly agreed with the view that trainers' counseling skills enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. 19.7% agreed. However, 3.5% of the sampled deputy headteachers were undecided, 5.3% disagreed whereas 4.1% strongly disagreed. These findings corroborate the assertions of Nwoye (2011) and Kehrhahn (2012) that have had difficulty identifying specific training and counseling skills or approaches of training which professionals should adopt to improve their effectiveness in enhancing headteachers's acquisition of important skills to undertake finance management.

The study also revealed that a fair majority (69.6%) of the sampled deputy headteachers strongly agreed with the view that trainers' ability to integrate ICT enhances headteachers' record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 13.8% of the deputy headteachers. On the other hand, 1.6% of the sampled deputy headteachers were undecided, 10.6% disagreed whereas 4.4% strongly disagreed. These findings are also consistent with the findings of a study conducted by Kehrhahn (2012) which indicated that even when general trainers do report receiving academic instruction and/or professional development training related to the demands of different headteachers, they still do not feel completely prepared to instruct headteachers whose projects demand specific attention. These findings thus attest to the fact that professional training of trainers and stakeholders predicts management of finances amongst headteachers trainees.

Evaluation of Training Programmes and Headteachers' Financial Skills

The study also sought to find out how evaluation of training programmes impact on headteachers' financial skills. Majority of the headteachers respondents noted that assessment of the relevance of training materials is rarely undertaken. Headteachers noted that Training institutions rarely assess the relevance of training materials in order to enhance headteachers' acquisition of financial skills. During the interviews, one headteacher noted,

> *"Training institutions rarely assess how relevant the training materials are. They rarely assess whether the training materials contain book keeping, pricing and costing, investment and budgeting skills".*

These findings support the assertions of UNDP (2010) that, in training projects, all operations and issues that contribute to planning and implementation of a project are evaluated. According to UNDP (2010), these include effectiveness of training methods and training materials and the relevance of the training content. Most of the headteachers respondents stated that Training institutions do not frequently undertake a follow-up of headteachers' acquisition of financial skills. During the interviews, one headteacher remarked,

> *"Training institutions do not undertake an evaluation of the extent to which I have acquired financial skills".*

Staffing officers also echoed similar sentiments with majority responding in favor of the view that evaluation of headteachers' financial skills is not frequently undertaken. However, zonal education officers discounted this view. These findings support the assertions of Johnson (2013) who posits that having a well-structured evaluating system in place can help determine where the problem lies. views further corroborate the views expressed by Mingail (2012) in study conducted in Canada by Mingail (2012) who indicated that assessing the progress of headteachers trainees is one of the most important responsibilities of a finance deputy headteachers. These views point to the fact that evaluation activities should be integrated into the overall training plan to determine how effectively the training efforts are progressing. Out of the headteachers interviewed, most them responded in favor of the view that success of their training programmes is not adequately evaluated. During the FGD, a headteacher participant indicated,

> "*Training institutions only conduct an evaluation of the training programmes once a year. It is not undertaken quarterly nor is it undertaken on a continuous basis".*

These findings corroborate the assertions of Lubembe (2012) that the reason for evaluating is to determine the effectiveness of a training programme. This points to the fact that when the evaluation is done, it is hoped that the results are positive and gratifying, both for those responsible for the programme and for upper-level managers who will make decisions based on their evaluation of the programme. This affirms that the failure rates of most business ventures owned by headteachers is attributed to the fact that evaluation is rarely conducted to assess the levels of challenges which confront such ventures. However, zonal education officers discounted these views. On the same breath, most of the staffing officers supported

these views. However, zonal education officers disagreed. They indicated that evaluation of headteachers' training programmes is often conducted and is a continuous process designed to improve quality of the training headteachers receive. These results affirm that evaluation of the progress of headteachers' enterprises significantly influence headteachers' record-keeping, pricing and costing projections, investments and budgeting plans. These findings support the views expressed by Lubembe (2012) in his journal about efficacy of follow-up or programme evaluation on headteachers empowerment, Lubembe (2012) found that the reason for evaluating is to determine the effectiveness of a training programme. These findings thus affirm the fact that training institutions need to carry out evaluation of training programmes since it helps in improving the quality of training activities which in turn results in greater benefits for headteachers trainees. Results of the evaluation are used to guide decision-making around various components of the training such as instructional design, delivery, results and its overall continuation, modification or elimination. Data was also collected from deputy headteachers and results are shown in Table 5;

Table 5: Findings of the Effectiveness of Evaluation of Training Programmes on Headteachers' Financial Skills

Summary of Test Items	SA %	A %	U %	D %	SD %
Evaluation of relevance of the training curriculum enhances headteachers' financial skills	58.8	21.6	4.1	10.4	5.1
Evaluation of headteachers' finance skills enhances headteachers' financial skills	61.6	17.7	3.9	10.5	6.3
Evaluation of programme success enhances headteachers' financial skills	59.9	19.8	2.5	12.2	5.6
Evaluation of progress of headteachers enterprises enhances headteachers' financial skills	65.9	13.4	3.7	10.3	6.7

Table 5 reveals that slightly more than half (58.8%) of the deputy headteachers strongly agreed with the view that evaluation of relevance of the training curriculum enhances headteachers' acquisition of record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills. At the same time, 21.6% agreed. On the contrary, only a small proportion of 4.1% of the sampled deputy headteachers were undecided, 10.4% disagreed whereas 5.1% strongly disagreed. These findings corroborate the assertions of Johnson (2013) who posits that having a well-structured evaluating system in place can help determine where the problem lies. In the same breath, training institutions need to carry out evaluation of training programmes since it helps in improving the quality of training activities which in turn results in greater benefits for headteachers trainees. These findings also lend credence to the findings of a study conducted in Canada by Mingail (2012) who indicated that assessing the progress of headteachers trainees is one of the most important responsibilities of a finance deputy headteachers. These findings thus attest to the fact that evaluation activities should be integrated into the overall training plan to determine how effectively the training efforts are progressing. The study also revealed that a fair majority (61.6%) of

the sampled deputy headteachers strongly agreed with the view that evaluation of headteachers' finance skills enhances headteachers' acquisition of record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 17.7% of the deputy headteachers. However, 3.9% of the sampled deputy headteachers were undecided, 10.5% disagreed whereas 6.3% strongly disagreed.

These findings are consistent with the assertions of UNDP (2010) that in Kenya, most training institutions have embraced the principles of evaluation and follow-up of the headteachers training on finance skills. This is usually done at the end of a major project cycle, such as after one, two, or three years. Similarly, slightly more than half (59.9%) of the deputy headteachers strongly agreed with the view that evaluation of programme success enhances headteachers' acquisition of record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 19.8% of the deputy headteachers. However, 2.5% of the sampled deputy headteachers were undecided, 12.2% disagreed whereas 5.6% strongly disagreed.

Majority (65.9%) of the deputy headteachers strongly agreed with the view that evaluation of progress of headteachers enterprises enhances headteachers' acquisition of record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills as did 13.4% of the deputy headteachers. However, 3.7% of the deputy headteachers were undecided, 10.3% disagreed whereas 6.7% strongly disagreed. These findings support the views expressed by Lubembe (2009) in his journal about efficacy of follow-up or programme evaluation on headteachers empowerment, Lubembe (2012) found that the reason for evaluating is to determine the effectiveness of a training programme. These findings thus affirm the fact that training institutions need to carry out evaluation of training programmes since it helps in improving the quality of training activities which in turn results in greater benefits for headteachers trainees.

SUMMARY AND CONCLUSIONS OF RESEARCH FINDINGS

It is evident that training of headteachers can be conducted in different modes which include; on-job, off-job, just-in-time training, mentoring and networking. These forms of training models enhance headteachers's record-keeping, investment, pricing and costing and budgeting skills. These findings attest to the fact that training of headteachers in different self-help groups can be conducted on the job, which is carried out at the headteachers's workplace, and off-the-job which is carried out away from headteachers's workplace. Finance training content influence headteachers's finance skills. Suitability of training materials enhances headteachers's record-keeping, investment, pricing and costing and budgeting skills. From the study findings, it is evident that the most important variable in such success is a well-prepared and capable trainer or facilitator. That is, a trainer with a grasp of record-keeping, investment plans, pricing and costing projections, budgeting plans and e-Financing skills.

Evaluation of relevance of the training curriculum enhances headteachers's acquisition of record-keeping, investment, pricing and costing and budgeting skills. Assessing the progress of headteachers trainees is one of the most important responsibilities of a finance training officers and in training projects, all operations and issues that contribute to planning and implementation of a project can be evaluated. This includes many items such as the effectiveness of the training methods and materials used; the relevance of the training

content to the backgrounds of the headteachers trainees; the knowledge, attitudes and skills gained by the trainees and the types of services delivered by the trainers.

RECOMMENDATIONS

The study thus, recommends that training institutions should design and plan quality integrated training programmes to match headteachers work schedule. Training materials need to be specifically designed to suit the content of training programmes in order to enhance faster understanding of concepts to be learnt. The training material should be redesigned to also focus on acquisition of financial skills. Trainers' need to update their skills to match the changing times such as adopting use of ICT and attitude change towards headteachers empowerment. Trainers should also have basic training and understanding of gender-related issues and concerns so as to be in a position to understand the challenges which confront headteachers and make them not to attend any training. Training institutions and trainers need to plan for quarterly and semi-annual evaluation of training programmes since they are effective in ascertaining of the efficacy of such programmes.

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Board Involvement on Earnings Per Share (Eps): Evidence from A Developing Economy

NWOKWU, TOCHUKWU CHRISTIAN (Corresponding Author)
Post Graduate & Mid-Career Development Unit, University of Colombo,
Colombo, Sri Lanka.
toojahchris@gmail.com

PRADEEP, M. P. DHARMADASA
Department of International Business, University of Colombo,
Colombo, Sri Lanka.
pradeep@mkt.cmb.ac.lk

PRASATH, D. L. M. RATHNASINGHA
Department of Finance, University of Colombo,
Colombo, Sri Lanka.
prasath@dfn.cmb.ac.lk

ABSTRACT

This research aims to investigate the effect of board involvement on earnings per share. The current study uses the correlation and regression models to analyze publicly available data for a sample of 69 firms quoted in the Nigerian Stock Exchange for the fiscal year 2011. This indicates that the research made use of cross sectional data. Several diagnostic tests have been applied to justify the validity of the results. The empirical investigations reveal that director' shareholdings, board size and board skills have significant impact on performance. Good corporate governance standards are very essential to every organization and should be encouraged and practiced for the interest of the investors, shareholders and other stakeholders. Is worthy of note, that from a developing country like Nigeria, especially in sub-Saharan Africa, this paper is the first of its kind and offers evidence on the effect of board involvement on earnings per share. The paper provides useful information that is of great value to policy makers, academia, corporate firms and other stakeholders.

Key Words: Board Involvement, Earnings per Share, and Firm Performance

1. Introduction

As a result of the responsibility vested on the boards of directors to monitor and manage the firm's activities due to some corporate scandals and malpractices, as well as the potential to increase the company's

performance through their involvement in the strategic process and through building relationships with key investors. However, shareholders and other stakeholders are having great expectations from them, and this has made the board of directors to be under scrutiny to ensure that their active involvement yields expected performance. Thus, the importance of board involvement in achieving corporate performance cannot be overemphasized because they help set organizational goals and boundaries as well as maintain the strategic plan towards attaining the performance level the firm desires. Hence, any failure of the board is a failure of the company's performance. So, given the purpose of governance as proposed, it would follow as a universal truth that the board as the direct recipient of owners' authority is accountable for all positions and functions to which it chooses to grant part of its derived authority, for that is the only way those positions and functions receive it (Carver, 2010). Firm performance is being represented with earnings per share in this research.

2. Literature Review

Historically, the study of corporate governance has been closely linked with the abuse of shareholders' interests (Ahunwan, 2002; Senaratne & Gunaratne, 2008). Shareholder activism has become a force for good in the extant corporate governance literature (Adegbite, Amaeshi & Amao, 2012; Fama & Jensen, 1983). However, the boards of directors can affect the strategy of their firms in two general ways. Boards influence strategy indirectly through "decision control" activities such as evaluating past decisions made by top management, performing high-level reviews of strategic plans, and monitoring executive and firm performance. Boards can also influence strategy through "decision management" activities such as ratifying strategic proposals, asking probing questions about important issues, and helping to formulate, assess, and decide upon strategic alternatives. Decision control is the board's most fundamental responsibility, but decision management is not traditionally considered a necessary board role (Fama & Jensen, 1983; Judge & Zeithaml, 1992; Chitayat, 1984). How the board's role is defined and the way it is structured is the two factors that help to determine the effectiveness of the BOD as a corporate governance mechanism (Cadbury Report, 1992; Carver, 2010). The board is expected to ensure managers' goal-congruent behaviour, and report to the shareholders on its stewardship (from stewardship theory perspective).

2.1 Research Framework

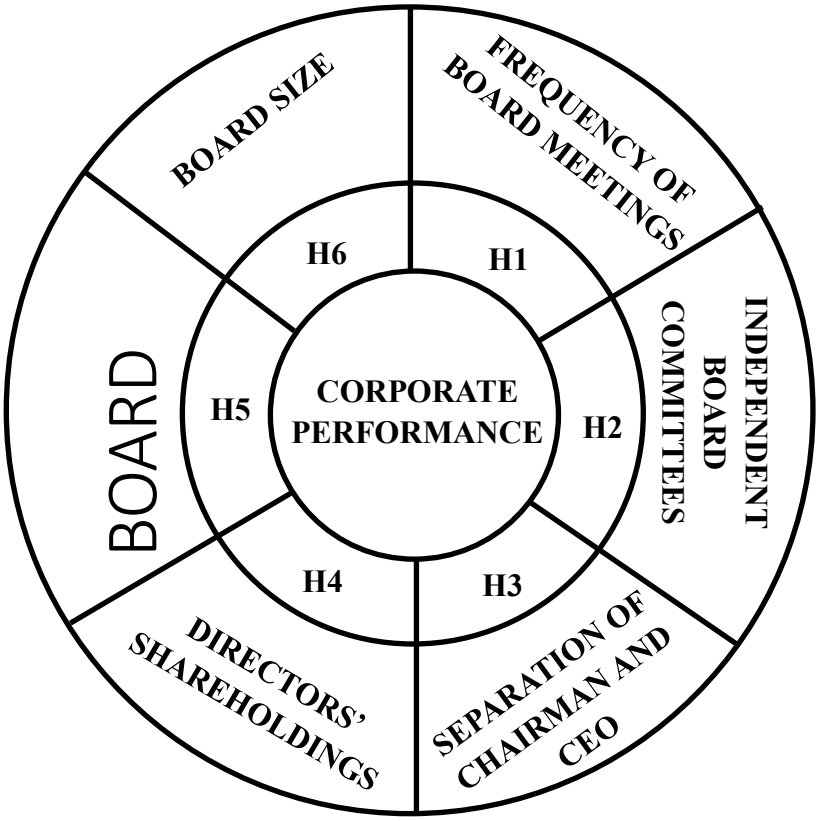

Figure 2.1: Research Framework

Source: Author's Survey Data.

H1. Frequency of board meetings is not associated with corporate performance.

H2. Independent board committees are not associated with corporate performance.

H3. Separation of chairman and CEO positions is not associated with corporate performance.

H4. Directors' Shareholding is not associated with corporate performance.

H5. Board Members' Relatives is not associated with corporate performance.

H6. Board's size is not associated with corporate performance.

3. Methodology

Empirical study on the impact of board involvement on firm performance requires selection of appropriate performance measure for objective analysis. Unbiased performance measurement is necessary for both strategic and diagnostic purposes.

The researchers use Earnings per Share (EPS) to measure the firm performance. EPS has been seen as one of the most used measure by researchers to evaluate corporate performance (Stickel, 1990 &. Wijethilake, Ekanayake & Perera, 2015). Furthermore, EPS is utilized to evaluate firm performance on board of

directors' commitments (Iyengar and Zampelli, 2009; Pearce and Zahra, 1991). Below is how it will be used to measure corporate performance:
EPS - is measured as net income divided by total shares (Azeez, 2015).

4. The Multiple Regression Models

$$EPS_i = \beta 0 + \beta 1FREQUENCYBM_i + \beta 2INDBC_i + \beta 3SEPCHAIRMANCEO_i + \beta 4DSHARE_i + \beta 5BRELAT_i + \beta 6BSIZE_i + \beta 7FAGE_i + \beta 8FSIZE_i + \beta 9BSKILL_i + \beta 10FLEV_i + \mu i \quad \ldots\ldots\ldots\

Table 4.2: Descriptive Statistics of Board Involvement

	FRE	INDBC	DSHARE	BRE	BSIZE	FAGE	BSKILL	FLEV
Mean	5.289855	3.811594	0.159135	0.173913	9.811594	36.55072	9.739130	0.554220
Median	5.000000	4.000000	0.061600	0.000000	9.000000	32.00000	9.000000	0.520500
Maximum	12.00000	6.000000	0.893500	1.000000	18.00000	117.0000	18.00000	1.521300
Minimum	2.000000	1.000000	0.000300	0.000000	5.000000	5.000000	5.000000	0.063400
Std. Dev.	1.863752	1.101808	0.206456	0.381812	2.936962	23.00865	2.893462	0.275184
Skewness	1.384200	-0.353064	1.457124	1.720618	0.930323	1.107770	1.003356	0.497798
Kurtosis	4.982928	2.990061	4.422937	3.960526	3.322628	4.588135	3.558992	3.550318
Jarque-Bera	33.33862	1.433810	30.23809	36.69856	10.25251	21.36352	12.47566	3.720427
Probability	0.000000	0.488261	0.000000	0.000000	0.005939	0.000023	0.001954	0.155639
Sum	365.0000	263.0000	10.98030	12.00000	677.0000	2522.000	672.0000	38.24120
Sum Sq. Dev.	236.2029	82.55072	2.898444	9.913043	586.5507	35999.07	569.3043	5.149395
Observations	69	69	69	69	69	69	69	69

Source: Author's Survey Data.

Correlation Probability	FRE	INDBC	DSHARE	BRE	BSIZE	FAGE	BSKILL	FLEV	EPS
FRE	1.00								
INDBC	(0.31)**	1.00							
DSHARE	0.03	-0.19	1.00						
BRE	-0.01	-0.03	0.03	1.00					
BSIZE	(0.43)**	(0.34)**	-0.20	-0.05	1.00				
FAGE	0.12	0.08	(-0.26)*	-0.23	0.00	1.00			
BSKILL	(0.34)**	(0.32)**	-0.19	-0.04	(0.98)**	-0.07	1.00		
FLEV	0.17	0.17	-0.20	0.03	(0.36)**	0.20	(0.34)**	1.00	
EPS	-0.19	-0.03	(-0.27)*	-0.03	-0.08	0.02	-0.05	-0.05	1.00

Table 4.3: Correlation Analysis

Source: Author's Survey Data.
** and * indicate the significance levels at 0.01 and 0.05 respectively.

According to the correlation analysis, probabilities of the association between FRE and INDBC, FRE and BSKILL, INDBC and BSIZE, INDBC and BSKILL, BSIZE and BSKILL, BSIZE and FLEV, BSKILL and FLEV are all significant at 1% level, while DSHARE and FAGE, DSHARE and EPS are having significant association at 5% level.

DSHARE is the only independent variable whose hypothesis was rejected because it correlates with EPS, while FRE, INDBC, BRE and BSIZE are the independent variables whose hypotheses fails to be rejected because they are not correlated with EPS.

5. Regression Models and Diagnostics Tests

The researcher tested the appropriateness of the regression model using several diagnostic tests.

Table 5.1: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.220352	Prob. F(2,57)	0.8029
Obs*R-squared	0.529392	Prob. Chi-Square(2)	0.7674

Source: Author's Survey Data.

Probability of observed R square is 0.76. This is insignificant at 5%. It indicates that residuals are not correlated over the cross-sections and they are independent. This means that results are valid.

Table 5.2: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.561109	Prob. F(8,60)	0.8053
Obs*R-squared	4.802877	Prob. Chi-Square(8)	0.7784
Scaled explained SS	23.01082	Prob. Chi-Square(8)	0.0034

Source: Author's Survey Data.

Probability of the observed R-square is 0.77. This is insignificant. Therefore, variance of residual is constant. It indicates that residuals are having homoscedasticity and no heteroskedasticity problem. Accordingly, model is appropriate and providing valid results.

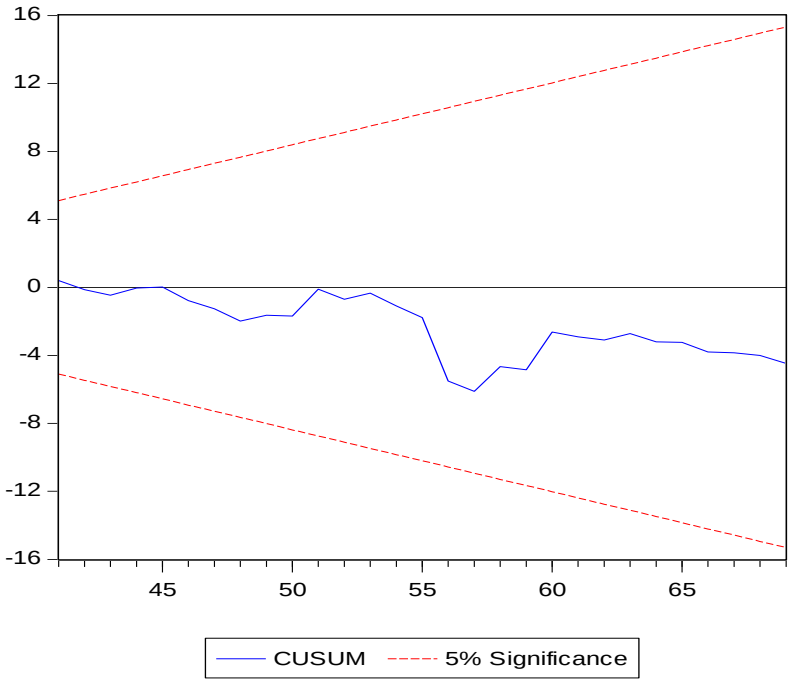

Figure 5.1: CUSUM Test

Source: Author's Survey Data.

The researchers tested the parameters stabilization using CUSUM test with respect to 5% level of significance. The curve behaves between the two (2) border lines. This indicates that the parameters of the regression models are stable. Accordingly, result is more valid. Furthermore, it also means that the model can be used for prediction because the model is valid.

5.1 Effect of Board Involvement on Earnings per Share (EPS)

The effect of board involvement on earnings per share has been analyzed using multiple regression models. Result is provided by Table 5.3.

Table 5.3: Individual Effect of Board Involvement on Earnings per Share (EPS)

Dependent Variable: Earnings per Share (EPS)
Method: Least Squares
Sample: 1 69
Included observations: 69

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.826	2.471	1.144	0.257
FRE	0.100	0.311	0.323	0.748
INDBC	-0.057	0.447	-0.127	0.899

DSHARE	-5.913	2.378	-2.487	(0.016)**
BRE	0.335	1.230	0.272	0.786
BSIZE	-2.798	0.984	-2.842	(0.006)**
FAGE	0.006	0.022	0.267	0.791
BSKILL	2.697	0.964	2.797	(0.007)**
FLEV	-1.365	1.804	-0.756	0.452

R-squared	0.303	Mean dependent var	1.123
Adjusted R-squared	0.197	S.D. dependent var	4.125
S.E. of regression	3.697	Akaike info criterion	5.586
Sum squared resid	806.385	Schwarz criterion	5.910
Log likelihood	-182.723	Hannan-Quinn criter.	5.715
F-statistic	2.852	Durbin-Watson stat	1.976
Prob(F-statistic)	0.007		

Source: Author's Survey Data.

** and * indicate the significance levels at 0.01 and 0.05 respectively.

Probability of F-test statistics is 0.007. This is significant at 1% level. Therefore, explanatory variables jointly influence on EPS. As the P-value is highly significant, regression model is appropriate.

Only Hypothesis 4 and 6 were rejected because DSHARE and BSIZE are both significant at 1% level. Also BSKILL is significant at 1% level.

Separation of chairman and CEO was dropped because it's having singular matrix problem. In other words, there is no variability in the variable. This implies that the sample firms have it in record that both the chairman position and the CEO position were occupied by two different persons throughout the research. Hence, hypothesis 3 was not analyzed.

The Durbin Watson test statistics is 1.97. This is between 1.5 and 2.5. Therefore, residuals are independent and the model is more appropriate.

Table 5.4: Relationship between Residuals and Explanatory Variables

Sample: 1 69 Covariance Analysis: Ordinary Correlation Probability	RESID
FRE	1.47E-15
P value	1.00
INDBC	-2.50E-15
P value	1.00
DSHARE	-1.10E-16
P value	1.00
BRE	2.68E-16
P value	1.00
BSIZE	1.22E-15
P value	1.00
FAGE	8.23E-16
P value	1.00
BSKILL	-4.56E-16
P value	1.00
FLEV	3.67E-15
P value	1.00

Source: Author's Survey Data.

In the table 5.4, probability of each independent variable is 1.00. They are perfectly insignificant. Therefore, residuals are not correlated with independent variables. The model is appropriate.

6. Discussion of Findings and Recommendations

This study has examined the relationship between board involvement and EPS in Nigeria. The results of the investigation are quite revealing.

Firms should at all times consider the shareholdings of directors, the size of the board and the skills of board members in order to achieve performance. The reason is because they are both jointly and individually significant with EPS. Directors' shareholding recorded negative significance on firm performance for EPS. The implication of this is that when directors' shareholdings increase, performance will reduce, and when there is a decline in directors' shareholdings, corporate performance will rise. In addition to the above point, DSHARE correlates with EPS.

Board size is having negative significant effect on firm performance at 1% level with EPS. Whereas, Azeez (2015) found out that board size is having negative significant effect with EPS at 5% level. These differences might be as a result of varying contextual factors pertaining to research settings, such as national diversity, status of economies, political stability, institutional constraints, and cultural background. This is why Carver (2010) argues that there is no universal applicability of corporate governance. However, Morck & Yeung (2009) supported this argument by saying that corporate governance differs fundamentally across countries. This is true because, board size differs from company to company as well as from country to country. For example; Dutch "boards" on average are two-thirds the size of U.S. boards (Ees, Postma & Sterken, 2003). And some of these differences are seen in other factors as mentioned above. And also, due to their different contextual characteristics, developing countries are likely to experience issues that may not be prevalent in developed countries (Achchuthan & Kajananthan, 2013). This indicates that there is a need to develop models of corporate governance that consider the conditions in each developing country and that are not directly borrowed from developed countries. Furthermore, Chisanga (2010) argued in same direction by saying that corporate governance is not about quick fixes, but a methodical and patient process that must be relevant and appropriate to each country's stage of development.

The implications of board size having negative significant effect on performance is that, when board size increases, firm performance will reduce and when board size reduces, corporate performance will increase. This result is consistent with Dharmadasa, Premarthne & Hearth (2014) argument, which supported the claim that small board size has influenced on firm performance. Hence, the board should be composed in such a way as to ensure diversity of experience without compromising compatibility, integrity, availability, and independence.

Further findings reveal that BSIZE is significant in relation to EPS. EPS has been operationalized with respect to net income and total shares. Accordingly, BSIZE is having a significant association with net income and total shares. EPS result is consistent with Azeez (2015) and Wijethilake, Ekanayake & Perera (2015). DSHARE and BSKILL are also having significant association with net income and total shares.

Firms with board members having the required skills and experiences will encourage learning, teamwork and effective performance. However, EPS recorded positive significance at 1% level for board skills. This implies that as board skills increase, firm performance will also increase and any decrease in board skills will automatically decrease firm performance. This is why there is need for firms to have policies that ensure the consideration of potential board members' experiences before appointment to the board. Also,

there is the need for continuous training and development for board members in order to ensure efficient discharge of their responsibilities.

The positive significant effect of board skills can also be as a result of appointing board members who have the qualifications and experiences, and their expertise is of good to the company. In other words, board members having adequate mixture of the qualifications and experiences needed to yield performance. Thus, board members should be thorough in their areas of specialties.

Even though some of the other independent variables are not individually significant with EPS, they are jointly having effect on EPS. Therefore, it's of paramount important that those variables should not be taken in isolation; rather they should all be considered jointly in order for them to really have jointly effect on corporate performance.

Though this research focused on Nigeria, but it's worthy of note that the applicability of these recommendations and suggestions should not only be limited to Nigeria but to other developing countries and developed countries who sees what will be of great importance to their corporate governance practices when they apply such recommendation(s) and suggestion(s).

7. Limitations and Further Research

During the period of this research, the researchers encountered some limitations. Such limitations are the unavailability of all the required data needed for this research and the study covers one country i.e. Nigeria. As further research, this study can be applied to different countries and also to different period of times.

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Innovation in peanut productive chain in Brazil between 1996-2016

Thiago Reis
Master in Agribusiness and Development candidate
Sao Paulo State University
Brazil

Ana Elisa Bressan Smith Lourenzani
Assistant Professor, Faculty of Science and Engineering
Sao Paulo State University
Brazil

Joao Guilherme Camargo Ferraz Machado
Assistant Professor, Faculty of Science and Engineering
Sao Paulo State University
Brazil

Abstract

Innovation enables organizations to achieve increased competitiveness, through increased productivity, organization and marketing, with the possible consequence of opening new markets. The case of agro-industrial chains it's not different, in which the innovations along the chain have repercussion in the whole sector. In this way, this article aims to analyze the contributions of innovation in the groundnut production chain between 1996 and 2016, which went from culture with an import profile in the late 1990's to the export profile in the 2000's. It was used a qualitative approach and a descriptive research based on bibliographic research in databases, such as FAOSTAT and CONAB. Through the research it was possible to verify that the technological, marketing and organizational innovations were of great contribution to the recovery of the groundnut culture.

Keywords: Innovation, groundnut, production, productivity

1. Introduction

The peanut (*Arachis hipogaea* L) is a legume that has its origin in South America, in the region between latitudes 10 ° and 30 ° south. Because of its short-cycle crop, wide adaptability (to temperature, water and soil conditions) and because it is cultivated in several tropical regions of the world, it has great economic importance, being highlighted in the world agricultural scenario [1][2]. Peanut production in Brazil has undergone strong oscillation over the decades. In the 1960s, the country was one of the largest producers in the world, while between the 1970s and 1990s, the crop declined sharply, forcing the country to become an importer of the legume. The organizations involved in the peanut productive chain has taken several

actions that have led to improved competitiveness. In 2014 Brazil became the 18th largest peanut producer in the world [3].

In the 1960s, the states of São Paulo and Paraná stood were the main regions to supply peanut oil to the domestic market and peanut bran to foreign market. However, the expansion of soybean crop in the 1970s and 1980s, which dominated the production of oils and by-products in order to supply international demand for proteins, specially destined to animal feed, and the low profitability of the peanut crop, besides the technological lag (mainly in the harvesting process), has contributed to the supply of a low quality product. Between 1977 and 1988, the lack of standards for the control of aflatoxin, a mycotoxin with a high carcinogenic power produced by the fungus Aspergillus flavus, reduced the frequency of transactions with importing countries, leading to a reduction in the competitiveness of Brazilian peanut bran in the international market [4][5][1][6][7][8].

There was a sharp decline in peanut grain purchases by the processing industry in the 1990s. The market opportunity for fresh peanut grain was the candy industry. However, that is a sector with more strict patterns and standards for quality and food safety. The new market demand has implicated in chances in the productive chain, such as new cultivars, management techniques, harvesting and post-harvesting [4][9]. During the 1990s the country had an import profile, reaching 7,342 tons in 1996 and exporting only 332 tons in the same year [10].

Starting in the 2000s, the Brazilian Association of the Chocolate, Cocoa, Peanut, Bullet and Derivatives Industry (ABICAB by its acronym in Portuguese) created the Pró-Amendoim label, with the intention to coordinate actions in the sector. The label has contribute to the creation and adoption of safety standards for human consumption, acting in the control and detection of aflatoxin, aiming at stimulating the productive chain to produce grains in accordance with the established limits of aflatoxin concentration. The companies invested in improving the quality of peanuts produced in Brazil, implementing Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Points (HACCP) and laboratory monitoring of industrialized products[1][11].

In this period, the improvement in the performance of the crop was evident taking into account the exports. From 2001 the country reversed the balance of exports / imports, registering in that year, 51 imported tons and 5,501 tons exported, remaining positive since then[10][12].

In view of such oscillations regarding crop performance and practices in order to reestablish peanut as a relevant crop in Brazil, the objective of this work was to analyze the types of innovation introduced in the peanut production chain that contributed to the recovery of culture from the late 1990s and early 2000s.

This article has been structured in five parts, including this introduction. In the second part, the methodology used for the elaboration of this work is discussed. The third part brings concepts about innovation and application of such strategies in the peanut production chain. The fourth part shows the results and the fifth part covers the final considerations.

2. Method

To meet the proposed objective this research used a qualitative approach. With regard to the objective, the research has a descriptive character and uses as a procedure a bibliographic research.

The qualitative approach is a method of scientific investigation that seeks to respond broad questions, which are clarified as the study develops [13]. The interest lies in unraveling the events that culminate in a certain outcome, that is, the interest is not only in the results, but how they were reached. The qualitative approach is based on a series of techniques in order to describe, decode and translate the understanding of the occurrence of a particular phenomenon, among the techniques is the descriptive research [14].

Descriptive research objectives to describe the characteristics of a given population or phenomenon or establish relations between variables. One of its most significant characteristics is the use of standard techniques of data collection, being one of the instruments that allow the researcher to describe the characteristics studied. In this research, the data collection has adopted two research instruments: bibliographic research and documentary research [15].

Bibliographical research was based on theoretical references published in books, scientific articles, thesis and dissertations. The content of these documents allows for the researcher to obtain data that will be explored in the course of the development of their research [16][17].

Documentary research uses diverse sources, such as scientific tables, official documents, reports, magazines, among others [16].

In order to meet the research objectives, a theoretical reference related to the theme of innovation and to the peanut productive chain, was developed from scientific articles available in Capes, Scielo and Google Academic Periodic databases. Production, productivity and cultivation data were accessed from the FAOSTAT databases, maintained by the Food and Agriculture Organization of the United Nations (FAO) and the National Supply Company (CONAB by its acronym in Portuguese). FAOSTAT allows for data of exports / imports in the analyzed period, while CONAB offers an overview of peanut production in Brazil. The data collected comprised the 1990s and 2000s, a period that included the decline of peanut cultivation (1990s) and its recovery (2000s), when the country ceased to be an importer and became an exporter.

The year 1996 was chosen for the beginning of the analysis, since the first cultivar (IAC Caiapó) was launched that year. The cultivar has aimed to improve the performance of the peanut crop. It allowed for increases in production and productivity in the period, as well as the gradual increase in exports

3. Theoretical approach

The Organisation for Economic Co-operation and Development (OECD) defines innovationas the implementation of a new or significantly improved product (good or service), or a process, or a new marketing method, or a new organizational method in business practices, workplace organization or external relations [18].

Pigatto and Barcellos [19] argue that, throughout the decade of 2000, the concept of innovation has become broader than the innovations of product and process. Marketing innovation and organizational innovation have also been incorporated into the notion of innovation.

Four types of innovation have been identified: product, process, marketing, and organizational innovations. Product innovation is the introduction of a new or significantly improved good or service, using new knowledge or technologies or relying on existing technologies. Process innovation encompasses the implementation of a new or significantly new production or distribution method, based on techniques,

equipment or software. Marketing innovation refers to the implementation of a new marketing method, including changes in the packaging of the product and the positioning of the product in the shelves of the points of sale. Finally, organizational innovation refers to the incorporation of a new organizational method in the practices of a company, in the work environment or in external relations [18].

The meaning given by Schumpeter [20] to the development of innovation can be defined by new combinations, not necessarily linked to product and process. This concept addresses: (i) introduction of a new product, to which consumers are not yet familiar or with a new quality standard; (ii) introduction of a new production method, not yet experienced by the processing industry; (iii) access to a new market, not yet operated buy the firm; (iv) use of a new source of raw materials or semi manufactured goods, regardless of whether this source already exists or needs to be created; and (v) establishment of a new organization in any industry.

The competition theory proposed by Schumpeter has as main characteristic the functioning of the capitalist economy under a dynamic and evolutionary vision, based on an uninterrupted process of introduction and diffusion of innovations in a broad sense, which can be either changes in the products, in the productive processes, in the sources of raw materials, in the forms of productive organization, or in the markets themselves, even in geographical terms. In this sense, innovation is understood as a result of the constant search for extraordinary profits, by obtaining competitive advantages between agents (companies) [21].

In this sense, it is necessary to distinguish radical innovations from incremental innovations. According to OECD [22], radical innovations can be defined as those that have a significant impact on a market and the economic activity of companies, being a concept focused on the impact of innovations that can, for example, change the market structure, create new markets, or even render obsolete existing products. On the other hand, incremental innovations are characteristic of low and medium technology industries, usually focused on marketing, product differentiation and production efficiency.

When investing in technological transformation a firm may access advantages from being the first to develop innovation. While being imitated, the innovator's pioneering approach may result in several potential advantages which will remain after the end of his technological leadership. However, the attractiveness of the implantation of a technological innovation increases with the difficulty of the competition in imitating it [23][24].

Tidd, Bessant and Pavitt [25] emphasize that innovation is a matter of knowledge, creating new possibilities by combining different sets of knowledge. Such knowledge may derive from experience, based on something already seen or experienced, or may result from a search process (by technologies, markets, competition actions, etc.). Knowledge can also be explicable in its form, encoded so that others can access it, discuss it, or transfer it. Or it may exist tacitly, that is, known, but without formulation.

The evolutionary path of Schumpeterian thought can be: (i) the dynamics of economic development understood as the development of new combinations (introduction and improvement of new products and processes, organizational changes and new ways of accessing the market); (ii) the phenomenon of creative destruction driven by entrepreneurs who introduce these combinations in conditions of disequilibrium; and (iii) the process of competition and market structure in which this phenomenon occurs. The emphasis given by this approach to the concept of innovations in a broad sense reflects the idea that it is not only a question

of emphasizing technological change, but any change in the economic space promoted by companies that seek advantages and consequent competitive gains [21][26].

An innovation strategy can have repercussions not only on the firm's activities, but also on the whole sector, that is, a technological innovation, can have repercussion on the dynamics of operation of the whole agroindustrial system. Observing these potential repercussions proves to be an important source of information on the direct and indirect gains from the implementation of innovation and when linked to products, processes or services, is the key to obtaining and maintaining its competitiveness [27][24].

Santos et al.[28] pointed out that, unlike the other sectors of the national industry, agribusiness stands out as one of the main sectors in the global market, in relation to the competitiveness of the production based on technological knowledge, being technological innovation the main factor for the performance of the sector.

Pigatto and Barcellos[19] added that the way innovation is used by farmers and the context of values and norms are of great importance to analyze innovations throughout the value chain, highlighting the need for an efficient flow of information among all the links in a chain, which can result in better chain productivity.

Gianezini et al.[29] state that the theme of innovation and the actions of the various stakeholders have been driven by economic concerns, marketing, demand pressures and investment; and recently for the demand for foods that promote some kind of health benefit.

Agriculture has characteristics which affect its dynamics and, consequently, the occurrence of technological trajectories. Initially, the technical bases of production depend largely on the natural conditions (transport routines, distance to the consumer center and specific cultivation with the use of a technology) that affect the technological trends. The different natural conditions can be compensated by innovations, although they can not be totally eliminated. In agriculture, the degree of technological appropriability is also very low, which implies a lack of attractiveness to research and development and other innovative efforts. In the agricultural sector, the need to increase production and productivity is latent, which consequently requires research and development [19][30].

In this context and in the face of a unfavorable scenario to peanut crop, the introduction of innovations at all links in the chain were of very important for crop recovery. In the following item some forms of innovation in the peanut production chain are verified.

4. Forms of innovation in the peanut production chain

In the 1960s, Brazil was one of the world's leading producers of peanuts, mainly in the production of oil to supply the domestic market. Subsequently, this market was replaced by soybeans, which became the country's main oilseed. The agricultural expansion to the Center-West, an agricultural frontier, due to the available technology and mechanisms of incentives through public policy such as rural credit, allowed for the development of commodities supply chains as of soybeans [31].

The peanut crop was losing its importance in Brazil as a result of the shift of landuse of peanuts by soybean, added to factors that involve the low quality of the peanuts harvested in the country.

Only in the late 1990s the main actors involved in the peanut agroindustrial system realized the need for urgent system-wide changes so that the chain regained its lost competitiveness. The changes occurred

through new techniques of cultivation, primary processing, storage, secondary processing and commercialization of this product in order to increase its profitability and quality [32].

Table 1 shows the increase in national peanut production and productivity, based on data from FAOSTAT[33], with increases of approximately 124% in production and 59% in productivity, demonstrating the growth of the crop in relation to these two variables over the last 15 years (between 1999 and 2014).

Table 1: Brazilian peanut production and productivity between 1999 and 2014.

Year	Production (thousand t)	Productivity (t/ha)
1999	179,421	1,772
2014	402,626	2,816

Source: prepared by the authors based on FAOSTAT[3][33].

Regarding production, technological innovations played a major role. In this phase, the demand for cultivars that better served the requirements of the candy industry became the great challenge, as well as the adoption of other technologies that could guarantee the quality of peanuts, such as new techniques of handling, harvesting and post-harvesting. Research led to the cultivars IAC Caiapó, IAC Tatu-ST and IAC Runner 886, the most cultivated in the State of São Paulo [9].

Martins [9] and Vicente and Sampaio [34] highlighted that the cultivar IAC Caiapó was launched in 1996, while the cultivar IAC Tatu-ST was officially launched in 2000 and the cultivar IAC Runner 886 was launched in 2002. In the period from 1998 to 2005, when the new technologies were being introduced, the instability of the area and production variables was remarkable; there were no significant changes in productivity, demonstrating that the effect of technological variations was not immediate. There was also an increase in production between the years 2000 and 2001, since at that time, 53% of the area was cultivated with the new varieties, representing an increase of 9.81% in production. Between 2011 and 2016, peanut production in the state of São Paulo increased by 111%, from 178.9 thousand tons in 2011 to 377.5 thousand tons in 2016. During this period, the area planted was increased by 88%, from 57.3 thousand hectares in 2011, to 102.8 thousand hectares in 2016. Table 2 shows the data of planted area and production between 1996 and 2016 in the state of São Paulo.

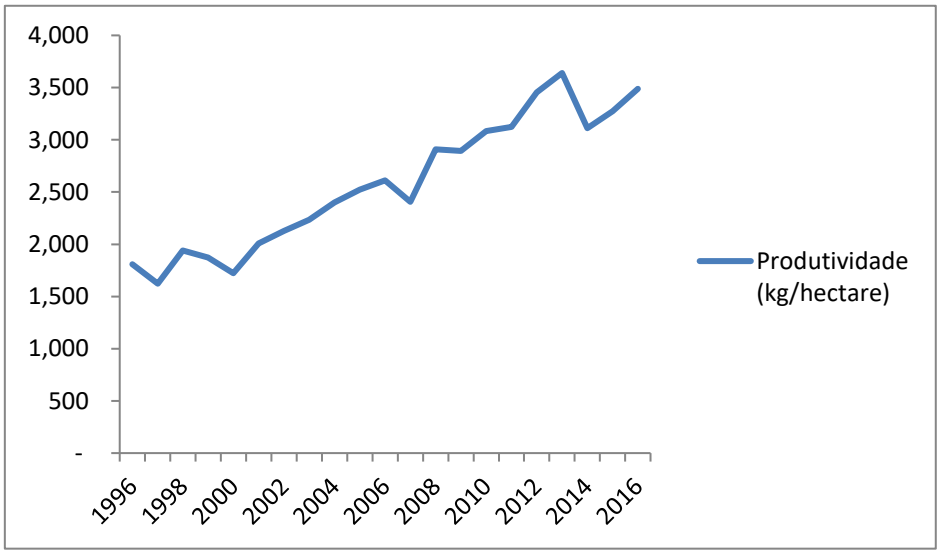
Productivity in the state of São Paulo between 1996 and 2016 was marked by instability. The period between 1996 and 2000 presented numbers ranging from 1,808 kg/ha in 1996 to 1,722 kg / ha in the year 2000 (decrease of 4.7%). It should be observed that the first new cultivar (IAC Caiapó) was introduced in 1996 in the state of São Paulo. However, its adoption has reflected in increasing productivity from 2001 on. From 2001 to 2006, productivity has increased, reaching its apex in 2006, with 2,611 kg/ha, representing an increase of approximately 44% when compared to 1996). The next period, from 2007 to 2016 has presented some instability but the increase in productivity was remarkable, over 300% (Figure 1).

Table 2: Area and production between 1996 and 2016 in the state of São Paulo

Year	Area (thousand hectares)	Production (thousand tons)
1996	62,5	120,2
1997	72,5	117,8
1998	85,1	165,1
1999	81,9	153,4
2000	87,0	149,8
2001	81,9	164,5
2002	74,0	157,4
2003	65,5	146,4
2004	73,2	175,7
2005	89,6	226,1
2006	79,6	207,8
2007	72,0	173,4
2008	81,3	236,4
2009	80,9	234,1
2010	55,3	170,5
2011	57,3	178,9
2012	75,9	262,3
2013	80,5	293,0
2014	92,2	286,8
2015	95,1	311,5
2016	108,2	377,5

Source: prepared by the authors based on CONAB [35].

Figure 1: Productivity (kg/ha) in the state of São Paulo between 1996 and 2016



Source: prepared by the authors based on CONAB [35].

Although the relation between production, cultivated area and productivity increase is one of the most important contributions of the innovative peanut cultivar, other elements must also be addressed, such as grain characteristics and quality, which has allowed for value aggregation to the grain and new marketing channels, both for the domestic market and for the external market. This innovation is considered the main reason for the increase in peanut exports, after a period in which Brazil was characterized as an importing country [9].

Regarding harvest and post-harvest introduced technology, Martins [9] and Scalco, Machado and Queiroz [6] argue that the use of these technologies contributed to the increase of productivity and to the improvement of the quality of the grain, turning the culture into a profitable choice for farmers. Investments in new storage technology, such as big bags, and in aflatoxin detection tests were elements that sought to guarantee the quality of the grain and its possibility of access to external market.

The consumer market have raised its standards, which demanded not only technological changes in the peanut chain, but also organizational changes of great importance for the adoption and creation of products destined for human consumption. In 1999, the European Union established that the permitted amount of aflatoxin in the grains should reduce from 20 ppb (parts per billion) to 4 ppb [36]. Such change has lead the sector to create the Pro-Peanut Program by The Brazilian Association of Cacao, Chocolates, Candies and Byproducts Industry (ABICAB, by its acronym in Portuguese). The Program have established grades and standards related to food security. A label created to communicate final consumers that the product was industrialized according to strict quality control.

Other important factors were the public standards. The Resolution RDC-172 was published in 2003, and provided the technical regulation of Good Manufacturing Practices for firms that use peanuts and its byproducts. Further, in 2009, the publication of Normative Instruction n.3 by the Ministry of Agriculture established several requirements to regulate the peanut production chain as adequate packaging and conditions to maintain final product quality. Other requirements were storage minimum conditions, total aflatoxin concentration, adoption of Hazard Analysis and Critical Control Points (HACCP), traceability, certification, amongst others)[37] [7][38].

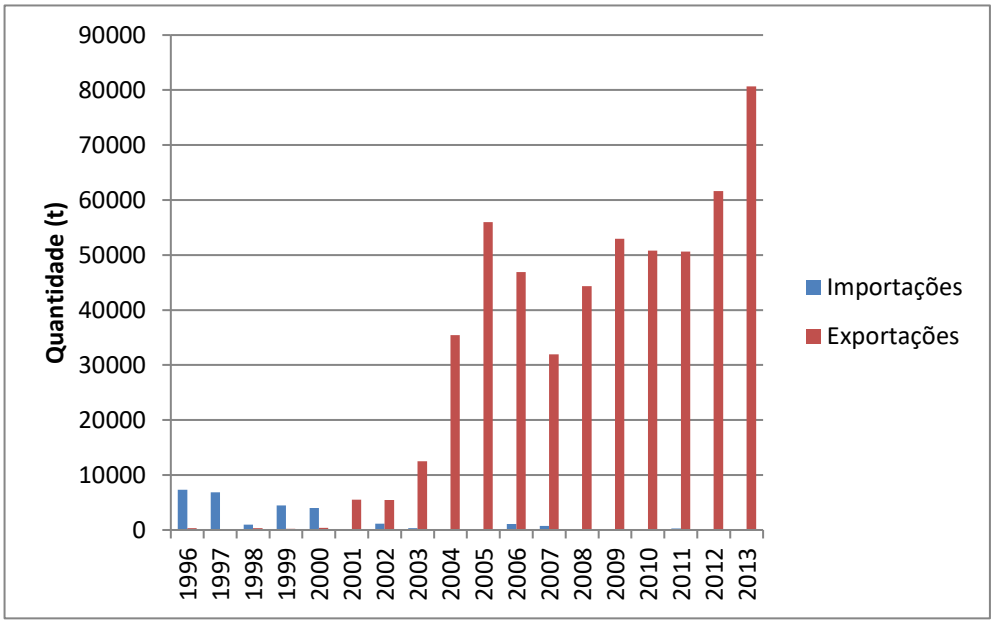
The Pro-Peanut label is awarded to companies that meet the requirements of the legislation and manufacture fully safe peanut based products and focuses on the prevention of aflatoxin, a toxic substance that can cause cancer and other diseases [39]. It is a label placed on the packaging in order to communicate compliance with the quality parameters, seeking to create safety for consumers and distribution channels, to give credibility to the industry, to facilitate the identification of good manufacturers, to develop a good image and to increase the consumption of peanuts [38].

João and Lourenzani [32] pointed out that the monitoring of product quality, through the Pro-Amendoim label, has as a result, the recognition of product quality, both in the domestic market and in the external market. Actions such as HACCP, Good Manufacturing Practices and ISO certifications are requirements of the external market.

Such actions helped Brazil to move from a importing country in the 1990s to an exporter in 2013. Figure 2

shows the exports and imports of Brazilian peanuts in shell between 1996 and 2013. Between 1996 and 2000 imports were much larger than exports. The largest quantity imported in this period was 7,342 tons in 1996, against 332 tons of exportation. The situation began to reverse in 2001, when the country exported 5,501 tons, while importing only 51 tons of peanuts in shell. From 2001 on the exports were higher than imports. Thus, it is observed that the creation of the Pro-Amendoim label, Good Manufacturing Practices, HACCP and certifications have contributed for meeting the international demands regarding the hygienic-sanitary quality of the grain.

Figure 2: Exports and imports of peanuts in shell between 1996 and 2013



Source: prepared by the authors based on FAOSTAT[10][12].

5. Final remaks

The innovations were a very important factor for the recovery of the peanut crop in Brazil. The contributions were not restricted to product technology as genetics, harvesting and pos-harvesting, but also to the organizational aspect, which were altogether responsible for production increase.

With the advent of new cultivars, production and harvest were positively affected, mechanized harvesting was also a key part of crop recovery. The increase in exports between 1996 and 2013 shows the positive result of technological innovations in the peanut production chain. In addition, the post-harvest technology is of great importance to ensure the quality of the final product. Therefore, technological changes related to the processing are relevant. These changes involved new artificial drying techniques, which involved controlled storage, maintaining relative humidity of the air and the tamperature in optimal conditions. Those factors are revelant to combat the high levels of aflatoxin.

It was observed that the increase in exports was not only result of technological innovations, implemented in the production and processing of peanuts, but of several organizational innovations adopted by the chain agents throughout the decade of 2000, especially the creation of the Pro-peanut label. The label was an innovative way to communicate, through visual information, about quality of product and of process in a

symbol that could be perceived by consumers. Thus, it is considered that the seal was also a source of innovation, in this case marketing innovation.

With the organization of the peanut production chain, the guarantee of product quality, the positive production numbers and the marketing strategy, through the Pro-Amendoim label, new markets were accessed. This was one of the directions given by Schumpeter to development. Since 2001, with the recovery of exports as a result of all the changes already mentioned, the natural consequence was accessing new markets.

Finally, it is concluded that the contribution of the different types of innovation were of great importance for the recovery of the peanut crop. It should be noted that the actions have involved the agents of the whole production chain, characterizing innovation as an important tool to increase competitiveness for the peanut chian, but also demanding governance and coordination.

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Analysis Of Salivary Cortisol And Its Relationship With Burnout Dimensions In Prison Workers

Sabrina Azevedo Wagner Benetti, Cíntia Beatriz Goi, Carolina Renz Pretto, Cátia Matte Dezordi, Marcos Benetti, Daiane Raquel Steiernagel, Pâmela Vione Morin, Eniva Miladi Fernandes Stumm
Universidade Regional do Noroeste do Estado do Rio Grande do Sul
Brazil

ABSTRACT

Workers in the prison system experience stress at high levels in their daily lives, so they become prone to the development of the Burnout Syndrome. In order to evaluate the occupational stress, the most sensitive and of easy access biochemical method is salivary cortisol. ***Aim:*** *to evaluate the concentration of salivary cortisol in prison workers and to relate it to the Burnout Syndrome.* ***Methodology****: a cross-sectional and analytical study with 240 prison workers from the 3rd Penitentiary Region of the State of Rio Grande do Sul in Brazil, covering 8 counties and 10 prison houses. The instruments of data collection used were a sociodemographic characterization form, the Maslach Burnout Inventory and some salivary samples. The data collection period was from April to June 2017.* ***Results:*** *It was observed an increase in the dimensions of burnout concomitant with the increase of salivary cortisol levels in the research participants.* ***Conclusion****: The population studied experienced occupational stress evidenced by the use of the burnout and salivary cortisol instrument analysis, which is an important physiological indicator.*

Keywords: Cortisol. Professional exhaustion. Workers. Prisons.

INTRODUCTION

Prison has a double function, that is, to be an instrument of punishment and to have the duty of modifying attitudes of People Deprived of Liberty (PDL) with the aim of reintegrating them into society and preventing the recidivism (MOLLEDA et al., 2015). These are the penitentiary servers roles, especially of the Penitentiary Agents, who are responsible for the safety of the inmates and the facilities (FINNEY et al., 2013). Due to the nature of their profession, they are exposed to several risks factors such as tensions and physical and mental exhaustion (FAGUNDES, COSTA and MOREIRA, 2017).

Workers in the prison system work in one of the areas more likely to the develop physical and mental health problems (MOLLEDA et al., 2015). These workers experience higher rates of occupational stress and of the Burnout Syndrome (SB) which result from organizational stressors and lead to negative results not only for them, but also for the institution (FINNEY et al., 2013). The authors point out that the structure and organizational environment are significantly associated to the occupational stress and SB.

In this sense, it is important to measure the cortisol dosage, insofar as it represents the physiological response of the organism to the stressors of the environment. Thus, to evaluate the stress, the cortisol dosage constitutes the most known and sensitive biochemical method (GUNNAR; QUEVEDO, 2007). It has an important role in research on worker's health because of its potential use to evaluate the physiological response in work groups exposed to overload and occupational stress (CAMPOS & DAVID, 2014).

The responsible for producing and releasing cortisol is the cortex of the adrenal glands, in the last stages of sleep, in order to prepare the organism for wakefulness. The concentration of cortisol on the awakening period is higher and decreases, gradually throughout the day reaching lower concentrations before the individual sleeps (NUNES, 2008). It is a hormone activated in the second moment of the reaction to stress, in the negative feedback to the brain, that regulates the restoration of neurophysiological functioning (McEWEN, 2000). Because it has receptors on basically all organs and directly affects the functioning of the Hypothalamic-Pituitary-adrenal axis, it alters systemic autonomic and immune-system functions (HELLHAMMER; WUST; KUDIELKA, 2009; LUPIEN et al., 2007).

Nowadays, in the stress research, salivary cortisol is the most frequently evaluated hormone, due to the ease of access (CHRIST-CRAIN et al., 2007). Other authors have confirmed that the determination of salivary cortisol is the most appropriate for the detection of excessive concentration of the hormone in the organism, due to the ease of obtaining the sample and for not requiring invasive procedures of high cost and complexity HELLHAMMER; WUST; KUDIELKA, 2009). Its correlation with plasma cortisol is about 90% of compatibility, which demonstrates the level of diagnostic sensitivity and favors scientific investigations (Rosal et al., 2004, TAYLOR et al., 2007).

These considerations reaffirm the importance of expanding studies that relate cortisol levels to burnout. It is a current and relevant theme and requires preventive actions to avoid damages to the physical and mental health of prison workers who experience stress in their daily work. In this context, the question made is: what level of concentration of salivary cortisol is related to the burnout syndrome in workers who work in the 3rd Penitentiary Region of the State of Rio Grande do Sul? The present study aims to evaluate the concentration of salivary cortisol in prison workers and to relate it to Burnout Syndrome.

METHODOLOGY

This study integrates the master's dissertation "Stress, burnout syndrome and salivary cortisol in penitentiary servers". This is a cross-sectional and analytical study. The participant workers had to meet the following inclusion criteria: to be a penitentiary worker and active laborer; to be a member of the Superintendency of Penitentiary Services (SUSEPE) belonging to the 3rd Penitentiary Region and to voluntarily participate in the research. Servers with difficulty to understand the issues that integrated the data collection instruments and workers who went through an invasive dental procedure due to gingival bleedings were excluded.

The target population consisted of 381 prison workers assigned to the 3rd Penitentiary Region of the State of Rio Grande do Sul in Brazil which is composed of eight counties and ten prison houses that belong to the following professional categories: Penitentiary Agents, Administrative Penitentiary Agents and Penitentiary Superior Technicians. In the data collection period, from April to June 2017, 88 servers

were not found in prisons, 11 were granted absence leave, nine were dismissed for health reasons, seven were on leave, five refused to participate, three were removed by the Prosecutor's Office General of the State, one was assigned to the union and one was on maternity leave. Thus, 254 workers participated effectively in the study.

The data was collected through the use of a protocol composed of a sociodemographic and occupational characterization form, the *Maslach Burnout Inventory (MIB*) and salivary samples. The form was elaborated by the researcher and included the following variables: sex, marital status, educational background, position, time of activity in SUSEPE, occupational class, place of residence, working hours load, option to act in the prison system. For the question concerning the reasons that led the worker to choose to be a penitentiary server, it was allowed the use of multiple answers.

The MBI assesses the *burnout* in relation to the personal feelings and attitudes of the professional in their work and in front of the others. The choice of the cut-off points in the MBI scores was performed by the 75th percentile, the same used in the validation study of MBI in Brazil (LAUTERT, 1995). In this way, each dimension was categorized in low / moderate or high level. For the analysis, the following three dimensions of burnout were used: For the Emotional Wear dimension considering the 75th percentile was found: Low / moderate level - score from 0 to 17; High level - score from 18 to 34; In the Depersonalization, dimension considering the 75th percentile, it was found: Low / moderate level - score from 0 to 9; High level - score from 10 to 17. In the Professional Incompetence dimension considering the 25th percentile, this one with a reverse score, it was found: Low / moderate level - score from 17 to 32; high level - score from 0 to 16.

To evaluate salivary cortisol levels, participants' salivary samples were collected by means of Salivette® tubes, properly identified and stored under appropriate conditions and location. The saliva collections were done by the worker himself, on cotton rollers of high absorption present in the Salivette® tube. There was no need for fasting; when the examination was performed after the main meals, there was a three-hour interval between meal and collection. Before collection, three hours without brushing the teeth were needed.

Collection procedure: The Salivette® was opened and the swab was removed and placed in the mouth to stimulate salivation. It was maintained for three to five minutes or the time needed to feel it was saturated with saliva; afterwards,it returned to the initial position in the Salivette® and the tube was tightly closed. The minimum volume of saliva required was 1.0 mL. After collection, the samples were kept under refrigeration (2-8ºC) and sent to laboratory analysis. The samples were processed in the Clinical Analyzes Laboratory and the cortisol was determined by the method of Electrochemiluminescence. The cortisol reference values were the following: Morning collection - 10h: <0.78 ug / dL; Afternoon collection: <0.24 µg / dL; Night collection: <0.24 µg / dL. The research data was recorded and organized in the Statistical Package for Social Science (SPSS), version 15.0. Descriptive statistics (upper and lower limit, mean, standard deviation, coefficient of variation), ANOVA, Student t and 95% confidence interval were used.

All the ethical aspects that rule research with human beings have been respected. The project, was approved by the Research Ethics Committee of UNIJUÍ (opinion nº 1.948.910, CAAE nº

63136916.6.0000.5350) after the consent of the Ethics Committee of the Penitentiary School of the State of Rio Grande do Sul in Brazil. Participants who agreed to join the survey signed a Free and Informed Consent Form in two copies.

RESULTS

Table 1 shows the reference values of the salivary cortisol analysis in prison workers during the morning or afternoon work shift. Among the participants, it was found that the majority had cortisol levels within the reference parameters, but 2.4% had elevated levels of salivary cortisol.

Table 1 - Salivary Cortisol analysis of penitentiary workers. 3rd Penitentiary Region of the State of Rio Grande do Sul. April to June / 2017.

Shift	Reference values	n	%
Morning	≤ 0,78 g/Dl	199	78,3
	> 0,78 ug/dL	5	2,0
Afternoon	≤ 0,24g/Dl	35	13,8
	> 0,24 ug/Dl	1	0,4

*14(5,5%) unsatisfactory samples for cortisol analysis.

Table 2 shows the dimensions of the MBI in which it is verified that 22.8% of the workers were found in a high level of *burnout* in the three dimensions; 10.05% of them presented a high level of burnout in the following two dimensions, Depersonalization and Professional Incompetence; 3% in Professional Incompetence and Emotional Wear and 40.4% in Emotional Wear and Depersonalization dimensions. The workers who had a high level of *burnout* in only one of the dimensions represented 26.3% in Depersonalization; 21.8% in Professional Incompetence and 9.1% in Emotional Wear. It was also verified that 66% of them were in low or moderate level of *burnout* in all dimensions of the Syndrome.

Table 2 - MBI analysis in the three dimensions of the SB of prison workers. 3rd Penitentiary Region of RS. April to June / 2017

Depersonalization			Emotional distress	
			High level	**Low / moderate level**
High level	Professional Incompetence	High level	13 22,8%	6 10,5%
		Low / moderate level	23 40,4%	15 26,3%
Low / moderate level	Professional Incompetence	High level	6 3,0%	43 21,8%
		Low / moderate level	18 9,1%	130 66,0%

Table 3 presents results of the use of descriptive statistics, Student t and ANOVA of the value of cortisol levels according to MBI. It was observed that in the general evaluation of the participants cortisol levels were higher and statistically significant, in participants who presented a high level of SB.

Table 3 - Descriptive statistics, Student t and ANOVA of the cortisol value according to SB levels of workers who work in the 3rd Penitentiary Region of the State of Rio Grande do Sul from April to June / 2017.

	Ll	Ul	Average	Standard deviation	CV%	p-value
MBI						Teste t
High level	0,079	0,990	0,311	0,207	66,56	0,028
Low / moderate level	0,060	0,915	0,244	0,175	71,43	

The averages differed for $p < 0.05$; Ll = Lower limit; Ul = Upper limit; 14 unsatisfactory samples.

DISCUSSION

The routes through which occupational stress produces adverse health effects is a challenge (Campos, Davis, 2014). It can bring consequences for the workers and the institutions, such as significant costs to the organization, due to absenteeism, lower productivity and health treatments (AKBARI et al., 2014). Occupational stress can cause damage to physical and mental health (SHAKERIAN et al., 2017). Among the occupational stressors are work overload and lack of freedom of decision (AKBARI et al., 2014). The authors point out that the workload of the Correctional Agents has increased in recent years due to financial and staff cuts and prison population growth. Consequently, they needed to increase the

workload and stay longer in the work environment. To cope with stress, they often resort to harmful habits such as increased alcohol intake, smoking and substance abuse.

SB is an occupational disease due to physical and psychological exhaustion, together with permanent stress at work (CORRÊA et al., 2017). The authors point out that burnout occurs mainly in those professions that have direct contact with people, such as nurses, police officers, penitentiary agents and teachers. It includes the following three dimensions: Emotional Exhaustion, Depersonalization and Professional Incompetence (MASLACH, LEITER, 2016). It is associated with unknown physiological changes of the hypothalamic-pituitary-adrenal axis and, consequently, the deregulation of the cortisol hormone (RIBEIRO; MOTTA, 2014).

Today, salivary cortisol plays a key role in workers' health research because of its potential use to evaluate the physiological response in work groups exposed to overload and occupational stress (CAMPOS, DAVID, 2014). It is the most promising marker to evaluate the response to neurobiological stress (KUDIELKA et al., 2012). Despite several studies on stress and cortisol published in recent decades, surprisingly, few studies have examined changes in cortisol levels in relation to burnout (PENZ et al., 2017).

The results of this research allow us to state that, the higher the burnout the higher the level of cortisol in the workers participating in the research. A study by Marchand et al. (2014) comes to meet this result. They assessed symptoms of burnout and salivary cortisol levels in 401 Canadian workers who work on day shift. The authors found that women were 56.1% of the workers with a mean age of 41.3 years. Emotional Exhaustion was more correlated with cortisol concentrations at dawn and at bedtime. Professional Incompetence only manifested itself at bedtime, while the dimension of depersonalization was not relevant. Burnout was characterized by a marked decline in the lowest concentrations of cortisol, 30 minutes after awakening, and the higher the burnout the lower cortisol levels found. Cohort Study, Penz et al. (2017) with 314 participants in Dresden, Germany showed associations between concentrations of hair cortisol and burnout. They found elevated levels of cortisol in individuals who reported various symptoms of burnout.

The results of the present study here analyzed show the relationship between SB and levels of salivary cortisol, which are in agreement with other international investigations. This shows the research gap that surrounds this theme allied to the use of a physiological indicator of stress.

CONCLUSION

The SB is present in the workers participating in the research, in all dimensions that integrate the instrument used, and salivary cortisol levels were also elevated. From these results, it can be stated that this population who experiences occupational stress, tends to become ill and that the evaluation of salivary cortisol is an important physiological indicator which can be used to evaluate these professionals.

These results can be used by managers, workers and researchers to expand SB knowledge and to instigate the development of more research on the subject and, in this way, to obtain more scientific evidence to prevent physical and mental health problems, with repercussions on the work quality with people deprived of their freedom, on the image of the prison system and on society as a whole.

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The Difficulties Encountered By Support Agents In Special Education With Physically Disabled Students

Dionei Alves Dos Santos, Fabíola Hermes Chesani, Claudete Santos Demetrio, João Pedro Euriques Batista, Matheulli Guilherme Corrêa de Andrade, Francielly Nalin
School of Health, University of the Itajaí Valley, Itajai, Brazil.
Email:fabiola.chesani@univali.br

ABSTRACT

The aim of this study was to analyze the difficulties encountered by support agents in special education with students with disabilities. The methodology was qualitative and exploratory. Data were collected through a semi-structured interview and analyzed through thematic content analysis. The participants of the research were 12 support agents in special education in elementary education who carry out their activities with students with physical disabilities in a municipal school network. In relation to the difficulties encountered by special education support agents, the following categories emerged: Training of human resources; Material and technological resources; Infrastructure and Accessibility; Teamwork and Inclusion only in theory. It was concluded that there is a shortage of resources in this scenario, and may influence the quality of education offered to students with disabilities.

Keywords: Special Education, Inclusive Education, disability.

1. Introduction

In recent years, in the Brazilian educational scenario, discussions about "Inclusive Education" have been carried out, expressing concernment regarding its quality and democratic offer to the population, equitably and horizontally. One of the goals of this movement is to bring new reflexions so that there is no type of discrimination whatsoever, being schools the ideal places for disabled and handicapped children to learn, grow and evolve with autonomy and independence. The inclusion principle seems to be the responsible element for providing "[…] changes that should benefit social groups who were historically pushed aside and kept at the margins of society and human rights […]" (FERREIRA, 2015, p. 92).

It is in this space that people develop and seek new knowledge through teaching-learning process, making this environment proper to exercise the applicability of school and educational inclusion, and it should also count on a team of active professionals, intervening coherently so that the proposal regarding the division of collective knowledge, between children with disabilities and those with no disabilities, is better disseminated. The term education inclusion is very commonly associated to people who have any kind of physical or intelectual deficiency, however, this view has been positively and gradually changing (MANTOAN, 2004; BRAZ-AQUINO et al., 2016).

Schools can still provide a safe and welcoming environment, valuing the differences as positive things and not as limitations or barriers, because it is, in fact, at school, that experiences are shared among one another, exchanging emotions and feelings, and where friendships are made and strengthen, new families and new social groups are made and put together (VELTRONE; MENDES, 2011; WILDE, 2014; GUERREIRO; ALMEIDA; SILVA FILHO, 2014).

From the perspective of inclusive education for the special education public, the main support system consists of special education services and specialized education services (SES). The public system has been organizing multifunctional resources classrooms or support classrooms, either at schools or partner institutions, aiming to offer accessibility resources and strategies so that barriers are eliminated, favoring full social participation and learning development.

The Ministry of Education of Brazil, through National Curriculum Guidelines for Early Childhood Education, along with the Secretariat of Basic Education, created a professional category called Support Professionals (SP) or Support Agents in Special Education (SASE), to be inserted into the classrooms, with specific attributions, such as: being a mediador for inclusion, facilitating and influencing the interaction among students with disabilities and the other children and personnel; socialization; helping out with the communication, as a interpreter; being responsible for personal care and hygiene, alimentation, locomotion for those who are not fully-independent; providing safety and assistance in the teaching-learning process (BRASIL, 2010).

Having a second teacher in the classroom is an example, either if he or she is present during all classes or just for a few moments, in the most diverse modalities: interpreting, supporting, monitoring or assisting. The participation of teachers from specialized education services may occur either in the planning or for the support of understanding the learning conditions of the students, as a way to help the pedagogical team.

Given the educational and legal situations, the agents of inclusive education are indispensable doers in the school context and in the learning-teaching process, because they are in constant contact with the disabled child, constituting the way of knowledge dissemination, besides being the facilitator for the learning process. It is considered that this professional may influence, in so many ways, his or her performance within the classroom environment (TAVARES; SANTOS e FREITAS, 2016).

According to Mantoan (2004), for school inclusion to become even more strengthened, it is necessary to innovate, to institute modernization efforts, to restructure existent conditions in the school environment that surround the students. However, it is known that disabled people find difficulties in their life path, facing all types of barriers, including architectural, environmental, social and educational ones. Fiorini e Manzini (2014) add saying that these difficulties are not merely related to the learning process of the students, but yet, are related to how the school environment is prepared to meet the challenge of being inclusive.

This study questions the difficulties encountered by agents of inclusive education towards physically disabled students. Based on this perspective, the present study has the objective of analyzing these difficulties.

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2. Methodology

In order to achieve the objective of this study, a descriptive, exploratory study was the best option, based on elements of a qualitative research, used when seeking perceptions and understanding about the general nature of an issue, opening space for interpretation (MINAYO, 2011).

The educational network of the studied municipality has 114 teaching units, distributed into seven full-time education centers, 66 pre-school centers, 3 education centers, one field school, 28 basic schools, 5 isolated schools and 4 school groups. Currently, there are 34 teaching units that include inclusive educational services, and, only 17 units met the desired criteria for this study, by having physically disabled students who need specializes educational services, and must be accompanied by SASE.

The inclusion criteria for this research were: being an employee of Itajaí - SC city hall as a SASE in a municipal education network in the region of Vale do Itajaí; acting in the municipal schools of elementary education with students with physical disability and that need specialized educational accompaniment. The exclusion criteria were: not accepting to participate in the study, not signing the free and clarified consent term and not being involved with inclusive education.

During the development period of the study, there were a total of 19 SASEs working with physically disabled children. Out of these 19, 12 accepted participating in the study by signing the free and clarified consent term, after being explained of the objectives of the study. The interviews only began after approval by the Human Research Ethics Committee, through protocol number 1.134.168/2014. Interviews were carried out from October 2016 to November 2016, and transcriptions from December 2016 to January 2017.

Data collection was carried out, then, from September 2016 to December 2016, through a semistructured interview, with opened questions that were pertinent to the subject of study. The interviews were held individually, at the schools where the professionals work, using the physical space provided by the institution's management. The average duration of the interviews was 30 to 45 minutes and they were recorded using the Sony recorder equipment, model ICD-PX 820. The researcher was previously enabled to conduct the interviews.

To keep the participants' anonymity, in order to avoid exposing them and respecting ethical principles, they were identified with the initial letter of "participant", P, followed by a decimal numeral in crescent order, like "1", according to the order of the interviews, referring to the sequential-increasing order.

The interview transcriptions were submitted to several readings for a better appropriation of the material and better identification of pre-indicators to form discussion themes. These pre-indicators were grouped, using the following criteria: proximity, similarities and complementation, thus composing the indicators.

From the reading process, data were grouped in an organized way, in a phase that Bardin (2011) denominates as material exploitation. During this moment, decisions taken during pre-analysis phase were

made effective, through the appearance of coding operations, corresponding to cut-offs, aggregation and enumeration, allowing a representation of content and its expression. During the same stage, categorization took place, which refers to rubrics or classes that were grouped into a group of elements, which are also known as registration units.

According to Bardin (2011), the third stage refers to the treatment of the results obtained, which made it possible to analyze the data obtained, treating them and having significant and valid results available. For this step to happen, two sub-steps were carried out, called inference and interpretation. Inference is related to the poles of attraction of communication, it occurred through the application of an instrument that guided what was intended to be investigated (interview script). As for the interpretation, this was beyond the manifested content of the documents (speeches of the participants), because it interested the researcher the latent content, that is, the meaning that will be found behind what had been learned. The crude results were then treated and molded in order to be validated, allowing the synthesis and selection of the results, inferring in relation to the intended objectives.

After the cut-offs, data were classified into major categories, which resulted into progressive grouping of the elements, triggering the emergence of subcategories, as well as the analysis of results for theoretical purposes. It should be noted that the titles of the categories were defined during the pre-analysis stages and during the exploration of the material.

3. Results and Discussion

The participants of this study were 12 Support Agents in Special Education (SASE), all women. The ages ranged from 29 to 51 years old; career time and experience ranged from 3 to 12 years. Regarding their experience and curriculum, 5 of them have a Master's degree, 3 of them have a degree in Pedagogy, 1 in History, 1 in Management, 1 of them is specialized in Special Education and another one in Education in Childhood. It is important to point out that the 5 professionals with a Master's Degree are studying to obtain their Degree in Pedagogy.

Having the objective of analyzing the difficulties faced by the support agents in special education with physically disabled students, the categories were defined as: Human Resources training; Material and technological resources; Infrastructure and Accessibility, Teamwork and Inclusion only in theory.

Human Resources Training

The inclusion of disabled children in regular schools still has a lot to improve, mainly concerning the academic education and training of the professionals who are directly in contact with these children. Human Resources training is the basis for their performance and a preparation for situations to come in their daily routine (FERRAZ *et al*., 2010; GLAT; NOGUEIRA, 2010; BISOL; VALENTINI, 2014; CARVALHO-FREITAS *et al.,* 2015).

Rabin (2017) considers that the process of lifelong learning is a necessary and indispensable resource to keep educators up-to-date and qualified before countless innovations and new information that emerge daily. This is necessary because, when dealing with special education with the focus on inclusive education, it is important for educators to be well-driven, immersed and prepared to be creative and original

during their jobs, since the traditional educational routines and method become insufficient to meet the learning needs and demands of disabled populations.

Tozoni-Reis e Campos (2014) report that, when putting professional training into perspective as an investment, a positive inclusive educational mindset is created, highlighting the importance of professional experience for a teacher in his or her lifelong learning and education process. This importance of daily professional experience is what SASEs also mentioned in their interview lines:

> […] there should be more, more preparation and education, more training for us, so that we have more information to know how to work, knowing how to deal with the needs of these children and how to conduct them. But in reality there isn't and when there is, not everybody can attend, we cannot go, many times, because we need to be at work. These meetings, training, lifelong learning lectures and so on, help us think and act differently, the student needs and expects us to be someone who brings new things to the classroom, someone who stimulates him/her thinking process (P 9).

Tardif (2012) describes that, regarding educators and teachers training, they have to seek balance between academic education and knowledge produced about teaching so that their practice is better structured and they are better understood. For this to happen, they need to be in constant contact with continued training, in and extra work training, so that their horizons and perception regarding the source of knowledge are broadened, and thus strengthening new concepts of what they will teach.

It can be noticed, through SASEs lines, their wish and will to have more information which provide and amplify their knowledge and experience, not being limited to superficial professional training, with no guidance and with purely theoretical courses and classes. These professionals mentioned that they would like to obtain practical training, related to simulations and exercises that bring them closer to their reality and routine.

> I think that there should be more training and lifelong learning meetings to help us get better at our jobs […] it should be a lifelong process because it is important, it clarifies out doubts. So we should have more resources like these at schools, having practical training and under an organized schedule. It is really sad that something so good and necessary, something that would help us understand how to better stimulate and conduct the kids and would make us think differently even about ourselves and our jobs, is still missing here (P 4).

According to Garcia (2013), one of the alternatives that make it possible to overcome the lack of training in the teaching environment, is based on the access to continuing education, or the lifelong learning process by educators. This practice must take place permanently for greater effectiveness in the construction of collective knowledge. These strategies can be used in different ways, like group dynamics, exercises based on practical simulations, experience exchange, among other exercises and activities,

providing moments of improvement of the knowledge necessary for educational activities, assuring more effective actions towards the reality of each professional.

The participants' speeches show the importance of training and preparation focused on the reality and knowledge of the educators. Their lines also show that these things must happen with active participation and compromise, otherwise the changes will not come:

> There are so many other things that we discuss that are not part of the school reality. The coordinator knows and needs to know our needs and the students' needs, we need to talk and discuss real, concrete things, things of our reality here, things that really happen in the classroom (P 4).

Based on the lines above, it is possible to realize that the participants of the study feel the necessity of obtaining more information and knowledge about the context they are part of, so that they can offer adequate service and learning to the student they accompany during their work days. Dias (2017) reports that it is responsibility of the managers of educational units (principals, supervisors or coordinators), along with their leaders (teams which work with the special students) to give a feedback, evaluating what is taught and what is learned. Parting from this strategy it will be possible to identify some points that require improvement, either by the acquisition of resources, or by investments in training and lifelong learning process to educators.

Material and technological resources.

The educators pointed out some factors related to their limitations and lack of resources for their daily practice and classes, such as instructive material, access to technology and lack of differentiated accessibility tools to complete educational activities in the classroom.

According to Vitaliano (2007), the inclusion of physically disabled students into the classroom depends on several factors, such as physical structure, material resources, a strong educational policy, accessibility and, in special, the educators' capacity to understand their importance to the teaching-learning process.

Regarding the lack of material resources, the participants of the study referred limited availability of materials, such as personalized and adapted notebooks for visually limited students, colorful games, computers with sensors that capture head movement or portable computers/laptops. Also, it was pointed out by them that, when such resources are available, they bring greater possibilities of succeeding at student inclusion. On the other hand, when these resources are not available, it becomes concerning because it limits the learning process, as they say:

> There is a resource problem indeed. When there is no material available, I even bring it from home, I help a lot, I improvise things out to teach sometimes. I bring a lot of material, games… but it still is little and I feel bad for that, because my student is being stopped from learning more, you know? I think we could have more contact with technology, computers and internet. I think it would be very

> useful to them, today it is possible to use digital animation as a teaching tool. My student has cerebral palsy, he watches everything I show him on my cell phone and tries to do it. I downloaded some instructive pictures to help him learn to put words together, I believe that it helps and we should use the internet in our favor for special education, but we don't have laptops available (P 3).

According to Cavalcante and Jiménez (2016), a research carried out in Tupanatinga/PE in 2016, with a team of educators who work in municipal schools of regular education in the inclusive context, they identified that access to resources and materials was also limited precarious, which, in the participants' view, prevents the student's growth due to the difficulties of accessibility, leaving the educator without many other possibilities to help the student, even though they improvise things out many times. This study is concordant to with what was presented by the participants in the present study, as they also report that they do not have access to resources and materials, making the inclusion process difficult due to this limitation.

Dias (2017) describes that, the lack of material resources in schools undoubtedly will be harmful to the teaching process, limiting the possibilities of learning. Therefore, educators should, in some cases, intervene evaluating the need to reinvent new learning models in the face of the diversity of learners and their particularities.

D'Amaral (2014) says that any institution that offers any type of education has the obligation to make available all the human and material resources indispensable to the satisfaction of the educational needs of its students, as described in Resolution 02 of September 11th, 2001, written by the National Education Council (CNE), guaranteeing an educational system of inclusive nature, without prejudice or discrimination, and with principles of equality and opportunity for all.

Another point highlighted by the study participants was the lack of assistive technology. In their perspective, the educational scenario they are inserted in is not prepared to welcome students as an inclusive environment. Below are the testimonials of the participants:

> For physical education activities, the teacher tries to include the student, but she can't go or run after the ball because her wheelchair is not adequate, it does not move very well, it gets stuck. In the classroom, she has difficulty to reach out for a pencil, she needs help to have her meals, so we need to adapt things for her. I had to adapt a spoon handle for my student. It worked out, it is adapted, but it is not the ideal (P 8).

> His pencil is 6b, I had to buy one, the other teacher bought another one, so that the boy had pencils to work, then adapted the pencils so he could hold it. They are aware of the student's deficiency and needs and do not send adequate material. Where is the commitment and where is the respect with the learning of these children? How will that make the child develop? How will that include the child

> and create autonomy? It will not. So, it should be more organized, the public system should invest in resources. I do not regret having to buy things for my students with my money, but it is not my obligation, you know? (P 10).

Varela and Oliver (2013) report that educational institutions should invest massively and be able to count on the availability and accessibility of resources such as Assistive Technology (AT), so that these things can act as facilitators and mediators in the educational process, enabling the promotion, participation, autonomy and inclusion of these students. Cavalcante; Jiménez (2016) and Redig; Glat (2017) reaffirm that the use of ATs in schools is a powerful tool that can and should be used by available to students with disabilities. By using such resources, consequently, the possibilities and facilities of these students will be expanded to achieve their independence and autonomy, as well as to enrich their performance in different activities.

Wajnsztejn e Zaneli (2013) report that team which works with special students should ponder about the necessary and compatible resources for each student. And when these assets are not available, they must be built by the educators with the help of the learners themselves. According to the same authors, this can be an interesting activity in the classroom, because the student, at that moment, will be developing their abilities, either their motor or cognitive ability, and their creativity, triggering greater interest. It also should count on the participation of the other students, fostering greater interaction in the environment. In this sense, both studies are in accordance, pointing out that due to the lack of material, the educators have to improvise so that the learning process takes place.

Infrastructure and Accessibility

Regarding infrastructure and accessibility, the participants of the study report several limitations. Structural problems are seen as barriers for the students, making it impossible for them to transit freely in the school environment, causing frustration since they can not interact with the other students, triggering isolation and lack of socialization. We can observe these reports in the following statements**:**

> There is no accessibility in here. I have a student that is a wheelchair user because she had cerebral palsy when she was born and she has no condition to access her own classroom. The bathroom door upstairs is too narrow. If she is doing something upstairs she can't go to the bathroom. There are no handrails and bathroom rails either (P 2).

> Today here at school, the physical structure is not adequate. The ramps are to steep, we don't have classrooms with resources, bathrooms are not adapted to these children, there aren't handrails or bathroom rails, there aren't safety signs (P 7).

It is important that the student does not encounter obstacles from the architectural or structural point of view, in order not to intensify mobility limitations, since the disabled student is the main protagonist of

this space and should feel integrated into its totality and not prevented from anything. In this perspective, according to Souza *et al.* (2016), the school environment, to be fully inclusive, needs to be accessible to all, enabling students to be independent and to conquer autonomy.

Nunes et al. (2015) describe that when thinking about the accessibility of a student who has some motor limitation, it is important that ramps, for example, are not too steep, respecting the standards designated by ABNT, allowing the access of wheelchair users and students which have balance disorders or any kind of mobility disorder to any space they want to go to. Such attention should be given not only to the availability of accesses, but also be to the existence of safety bars, handrails, etc. to support them, thus minimizing the risk of falls or traumas.

Duarte (2013) points out that the daily life of physically disabled people presents several obstacles and difficulties, which reinforces the need for efficient projects with adequate solutions to everyday activities. Coelho (2014) mentions that infrastructure in the school environment should be welcoming, accessible and safe in order to increase the student's interest and raise the rate of his or her stay in school. The architectural accessibility to disabled people or those with reduced mobility needs to be reconsidered, and the managers of these institutions should be involved in order to promote the necessary and compatible adaptations to overcome existing issues.

According to Fonteles and Mazzotta (2015), the challenge of basic schools is to enable the environment (structure, space, resources, etc.) to be adapted to the real needs of its students. In this same sense, Kuzuyabu (2016) reports that the difficulty of effectively including disabled students in regular classes is related to the lack of proper structural conditions, which may prevent the advancement of these students.

In this sense, authors cited above, affirm that these adaptations will become appropriate for each student when classroom doors are better designed (enlarged), allowing the entrance and exit of a wheelchair; adequate lighting; safety bars and handrails; accessible bathrooms and toilets and so on.

Teamwork

An environment where one works in community and without individuality mindset, becomes more harmonious and productive. In this sense, according to Pimenta (2012), when thinking about a school, as a place where people are educated for the future, triggering and producing new knowledge, it is necessary that a democratic management takes place. The interaction among educators becomes fundamental for successful learning. These ideas were expressed in their lines:

> We could really say that the inclusion process happens when there is interaction among us, professionals, among support agents and the teachers. If there is no interaction, there is no inclusion. This does not always happen, the teacher often does not even talk to me and the student sees it (P 1).

> If the teacher prepares a lesson on any subject, on water for example, the regular student will understand. But the disabled student, who has some limitation, will not be able to respond in the same way or at the same speed as the others respond,

> because he/she needs more time to absorb the content. That's where my work comes in, to help this child understand the content, our role is to help him/her develop that knowledge, to make it easier for him/her to understand, to use pictures, to use colors. This for me is inclusion, but this happens very rarely, there is a lack of this interaction with the teacher, but it lacks on acceptance on the teachers' part (P 4).

Breitenbach et al. (2016) point out that it can be understood that inclusive education is not restricted only to providing quality access to formal education for people with disabilities, but it is assumed that this environment should also be prepared to better accommodate these students. In this sense, the school and the professionals who work there must ensure that the access of these students does not run into barriers imposed by the existence of communication fragmentation among the team.

Cavalcante and Jiménez (2016) believe that students' learning process occurs when an integrated project is used among the professionals who work there, without individualities, based solely on the needs of their students. All the professionals involved with the specialized educational service must be connected in order to elaborate together strategies that allow and promote students' autonomy.

In order to ensure a broadly inclusive education in the school environment, it is necessary that the entire educational community is involved, as well as the effective participation of the family and society in the elaboration of actions that expand the coverage of special education programs, given that the school is considered as a social space for learning, training and developing people. An integrated work tends to bring better results to the collective (SILVA, 2009; SILVA et al., 2016)

> When we put this student into all the activities that the other students do, we are including them, so it is interesting that here at school we work together as well, from the lunchroom to the family environment. And bring this student to the activities with other students, so that he/she is part of this process. But I don't see the integration of the team, so we would have to strengthen this in our network (P 5).

> When the teacher is participative and gives me some freedom to work with the child and with him, it's nice, but it's not always like that! Sometimes I feel bad to see that the child is being excluded and consequently I am also being excluded! There were cases here at the school that I saw the student calling the teacher and saying "hey teacher, teacher I'm here", it is sad to see this (P 11).

Through the words of the study participants, we can interpret that a school when accepts students with disabilities or with special learning needs, needs to take these students in their diversity and be open for dialogue. In this sense, it is up to those involved with disabled students to understand that there are different forms of interventions to be instituted for this student. Help from other specialized professionals should be sought, in order to have the necessary adjustments made so that the student's learning process is

not compromised, since there may be a need to carry out individual educational plans at times (SASSAKI, 2013, DIAS, 2017).

It is important to emphasize that everyone who is involved in the art of education have essential functions and obligations regarding the functioning of the educational system, contributing considerably through their knowledge to the child and to the construction of a differentiated school. The team of educators, through their experiences and academic preparation, can provide and bring relevant subsidies, as a contribution to a better understanding of the inclusion process, as well as to make suggestions for educational practice to become more effective, contributing to improvements in everyday school life. But, this practice should occur collectively and not centralized in a single professional category.

The expectations about Special Education are numerous, and among them, that the environment and the teaching proposal are structured, either by the needs of students, their families, society or the academic community that accompanies them. An expressive element regarding the performance of professionals in the inclusive area refers to the professional experience and its role in this context, associated with sharing the workplace with other members of the team in the classroom. This signs that there is a need for improvements when it comes to proximity and interaction with other educators and when it comes to increasing knowledge about each one's tasks, so that a sense of competence can be achieved and can generate adequate responses and results in relation to the work (DIAS, 2017).

Inclusion only in theory

Even with significant advances in the educational process focused on inclusion for all, the participants report that there is still only an inclusion process that seeks to adapt to the legislation. This process is identified by professionals who work in classrooms in regular schools as being "wonderful and perfect, but runs beautifully only on paper/in theory", but in practice what is offered is an education without much quality and still fragmented when related to the attention to disabled children, as stated below:

> Inclusion is very beautiful, very wonderful, but only on paper/in theory, because in practice it does not happen. There is still a lot to be done, the school, the teacher, the support agents themselves need to understand more about what inclusion is, the society has no sense of the challenges we have. Including is allowing these students to be accepted and not pushed aside and isolated. I think professionals are still very closed to the inclusion process (P 2).

> Being the most realistic possible, I think that a lot of things are beautiful and wonderful in theory only! What happens is that we are very disappointed to see how the students are conducted, how they are seen and how they are treated. Because there are professionals who do not have the patience and the awareness that there is a special student inside the room, and that he or she needs special attention. They leave that special student in a corner, not including him/her, so that's

> why I tell you it's just on paper. He/she is not included into classroom activities, is not included with other students so-called normal (P 4).

According to Vitório (2013), the sooner we offer a more inclusive social environment, without discrimination, without preconceptions in face of the existing diversities and needs, the sooner people will be building values based on that and will be ready to take on a greater commitment to society.

Oliveira (2013) reinforces that, in order to minimize these anguishes, the team must be prepared, trained and oriented by its managers for the arrival of a new student in the school environment, so that the student's acceptance and insertion process occurs without obstacles or the imposition of barriers, and respect for the differences, individualities and values existing in each student should prevail.

According to Braz-Aquino et al. (2016), it is important to state that schools should not only concern themselves with ensuring and promoting only their students' access to these environments, but should enable them to attend these spaces permanently, strengthening bonds promoting success.

It is at school that the process of socializing and integration among people takes place, involving different groups of people from different ethnics, religions, habits, genders and skills, which strengthens the need of collectiveness.

Therefore, by understanding the existence of these differences in our daily life and in the environments in which we are inserted, schools could not be different, since it is in this space that the possibilities of integration must be expanded so that the development of skills that need to be developed takes place, mainly on those with disabilities.

In this sense, one can perceive, through the participants' statements, that although inclusive public policies are a reality, they are not yet fully and efficiently implemented in the school context. This fact is possibly due to the resistance professionals and the lack of a human resources policy that enables the adequate preparation of the school staff and community for the insertion of students with disabilities.

4. Conclusion

The study made possible to analyze the difficulties encountered by support agents in special education towards physically disabled students and their inclusion process, which were regarding the training of human resources; material and technological resources; infrastructure and accessibility, teamwork and inclusion only in theory.

The limits pointed out by support agents in special education with students with disabilities are not associated with a truly inclusive education and a specialized service advocated by Brazilian public policies, but it is associated with a segregating education model.

These difficulties directly affect Brazilian education. However, when recognizing these difficulties, it is possible to present these results to educational managers and to reflect and prepare feasible strategies for a true inclusion process, valuing the diversity of students in the classroom, their individuality, singularity, plurality and the particularities of each one of them, so that everyone is offered quality education in a horizontal and equitable way.

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Preliminary Study to Find Occurrence and Dynamics of Toxic Cyanobacteria in Nuwara wewa and Nachchaduwa wewa, Two Man-made Reservoirs in Sri Lanka

M.C.M. Zakeel[1], P.A. Weerasinghe[1], H.C.D. Wijayawardhana[1], B.A.D.G. Kumari[2],

[1]Department of Plant Sciences, Faculty of Agriculture, Rajarata University of Sri Lanka, Puliyankulama, Anuradhapura, Sri Lanka

[2]Postgraduate Institute of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka

Abstract

Bloom of cyanobacteria in water bodies causes devastating problems to the ecosystem and humans when they depend on these waters for drinking purpose. Microcystin and nodularin, produced by some cyanobacteria, are toxic for human and many other aquatic organisms. Nuwara wewa and Nachchaduwa wewa are two important reservoirs supplying water for drinking purpose in addition to agricultural use. Therefore, preliminary study was conducted to evaluate these reservoirs for the presence of toxic cyanobacteria and their dynamics is of importance to take proper measures to control cyanobacterial growth and to ensure supply of quality water for human drinking purpose. Water samples were collected for 12 months from both reservoirs and physic-chemicals parameters of water were also recorded. Correlations between the physico-chemical parameters of water and the cyanobacterial density were established. Toxic cyanobacteria were isolated and identified using conventional and molecular methods. 16S rRNA gene and mcy-A gene were targeted for molecular identification using PCR. Cyanobacterial density had strong positive correlations with some physico-chemical parameters such as pH, temperature and dissolved oxygen in both reservoirs. These parameters can be used as good indicators to evaluate the condition these reservoirs with respect to cyanobacterial bloom. Some cyanobacterial isolates recovered from both reservoirs harboured mcy-A gene, showing the potential of microcystin production.

Keywords: Cyanobacteria, Cyanobacterial toxin, *Microcystis*, Eutrophication, Molecular identification

INTRODUCTION

Cyanobacteria are ubiquitous organisms in aquatic environments. Their blooms in public water supply reservoirs have become a matter of ever increasing concern throughout the world due to their potential for producing toxic compounds such as microcystins (MC) and nodularin (NOD). Acute exposure to MS is reported to be a one of the contributory factor to cause liver failure and death in humans (Carmichael et al., 2001). Similarly, chronic effects have been reported with low level of exposure to MS (Fitzgeorge *et al*., 1994; Chorus and Bartram, 1999). Moreover, the outbreaks of human poisoning due to exposure of toxic cyanobacteria through exposure of contaminated drinking water have been reported in Australia (WHO,

1999). However, the worst case involving a human population due to exposure to MS had been reported in city of Caruaru in northeastern Brazil (Jochimson *et al*., 1998).

Production of MC depends on the existence of genes, encoding for MC synthetase. The *mcy* gene cluster is reported as a responsible operon for MC synthetase production (Tillett *et al.*, 2000). It has been reported that some cyanobacteria are unable to produce toxins, but all those have genes associated to MC biosynthesis (Ouellette *et al*., 2006). A few strains of cyanobacteria in nature have no MC production, but contain all the genes for MC synthetase production (Kurmayer *et al*., 2004). The toxicity of cyanobacteria cannot be evaluated by morphological characters due to lack of morphological differences between toxic and non-toxic types. Several authors have used *mcy* genes as molecular markers to identify the MC producing cyanobacteria (Baker *et al*., 2002; Nonneman and Zimba, 2002). Polymerase chain reaction (PCR) amplification of a fragment of *mcyA* gene had been used to identify MC producing genotypes of cyanobacteria in water reservoirs. Thus, the early detection of toxic cyanobacteria in water resources is advisable in order to avoid contamination and public health problems.

Ionization and cupric treatments are the only promising measures to get rid of the cyanobacterial toxins (Lambert *et al*., 1996). Cupric treatment kills the toxic cyanobacteria and it seems to be highly potential. More than 0.05 mg/L of Copper can be toxic to algae. Copper is an essential nutrient for animals at low concentration while toxic at higher concentration (Boyd, 2005). However, frequent use of this treatment is not advisable as other types of organisms may also be executed. Nuwara wewa and Nachchaduwa wewa are two important man-made reservoirs supplying water for domestic and cultivation purposes. People take water either directly from these reservoirs or irrigations channels of these reservoirs or even as tap-borne water supplied by the National Water Supply and Drainage Board from these reservoirs.

This preliminary study evaluates toxic cyanobacteria that inhabit Nuwara wewa and Nachchaduwa wewa and their seasonal dynamics with the change of physico-chemical parameters of water. This will help in applying measures to prevent the growth of toxic cyanobacteria and the accumulation of cyanobacterial toxins in drinking water.

METHODS AND MATERIALS

Study site and sample collection

Two man-made reservoirs, Nuwara wewa and Nachchaduwa wewa in Anuradhapura were selected for sampling in this study. Water sampling was carried out at four sites by main four directions; North, South, East and West. The coordinates of North, South, East and West sampling sites in Nuwara wewa were 8º 21’12.94’’ N & 80º 25’ 36.44’’ E & 306 feet, 8º 19’06.77’’ N & 80º 26’ 10.21’’ E & 289 feet, 8º 20’06.16’’ N & 80º 26’ 11.55’’ E & 297 feet and 8º 20’25.11’’ N & 80º 25’ 00.23’’ E & 291 feet, respectively. North, South, East and West sampling sites of Nachchaduwa wewa had the coordinates of 8º 16’ 29.87’’ N & 80º 28’ 55.37’’ E & 346 feet, 8º 14’03.17’’ N & 80º 28’ 56.26’’ E & 361 feet, 8º 15’13.73’’ N & 80º 29’ 13.06’’ E & 345 feet and 8º 15’07.60’’ N & 80º 28’ 13.50’’ E & 335 feet, respectively. The samples were

collected from two different layers; surface layer and bottom layer (one meter below the surface), at a rate of three samples per each layer at a sampling site with a total of 24 samples per reservoir per month.

Water samples were collected in sterile brown glass bottles every month starting from January 2012 to December 2012. The samples were instantly tested for physico-chemical parameters within a few hours in addition to primary microscopic observations. Formalin solutions of 4% and 6% were added into aliquots of samples to avert the proliferation of cyanobacteria with time to preserve the water samples for short and long terms, respectively (Soumati *et al*., 2005). For the proliferation of microorganisms, aliquots of samples without formalin were kept under room temperature.

Physico-chemical parameters of water

Temperature, pH, dissolved oxygen in water and turbidity were measured as physico-chemical parameters of the collected water samples. The temperature was measured using a standard Celsius thermometer. Turbidity meter (WalkLab) and pH meter (PCE 228) were used to measure the turbidity and the pH of water samples, respectively. All these parameters were measured at the time of sampling. The turbidity of water was measured in the unit of Nephelometric Turbidity Units (NTU).

Generic identification of cyanobacteria

Collected water samples were concentrated by centrifugation at 3500 rpm for ten minutes. The resultant pellet was serially diluted and inoculated onto BG11 medium to isolate cyanobacteria (Stanier *et al*., 1971). The generic identification of cyanobacteria was carried out based on morphological criteria according to keys of identification (Lawton *et al*., 1999). Colour, size, shape of colonies and trichome, and the presence of akinete, gas vacuoles, heterocyst and gelatinous sheaths were taken into account (Soumati *et al*., 2005).

Maintenance of cyanobacterial cultures

BG11 medium (Table 1) was prepared to maintain the cyanobacterial cultures (Rippka *et al*., 1979). After inoculation, the cultures were incubated at room temperature with 12 hours light-dark cycling until the culture grew well. Sub sampling was done to obtain a pure sample of cyanobacteria for further investigations.

Table 1: Composition of BG 11 medium

Ingredients	Quantity/L
$NaNO_3$	1.500 g
$K_2HPO_4.3H_2O$	0.040 g
$MgSO_4.7H_2O$	0.075 g
$CaCl_2.2H_2O$	0.036 g
Citric acid	0.006 g
Ferric ammonium citrate	0.006 g

EDTA	0.001 g
Na_2CO_3	0.020 g
Trace metal mix A5+Co*	1.000 mL
Deionized water	1 L

*Trace metal mix should be consisted of H_3BO_3, 2.86 g/L; $MnCI_2.4H_2O$, 1.81 g/L; $ZnSO_4.7H_2O$, 0.222 g/L; $Na_2MoO_4.2H_2O$, 0.390 g/L; $CuSO_4$ $.5H_2O$, 0.079 g/L; $Co(NO_3)_2.6$ H_2O, 0.0494 g/L

DNA extraction, PCR and molecular identification of toxic cyanobacteria

Five milliliter of exponentially growing cyanobacterial cells were harvested by centrifugation. Four isolates recovered from Nuwara wewa (NUW 01, NUW 02, NUW 03 and NUW 11) and three isolates from Nachchaduwa wewa (NCH 01, NCH 02 and NCH 09) exhibited exponential growth and were used for DNA extraction and PCR reaction. The cells were washed twice in wash buffer (Tris buffer, pH 8 – 100 mM, EDTA, pH 8 – 50 mM, NaCl 100 mM), and re-suspended in 200 µl of solution I (Tris buffer, pH 8 – 25 mM, Glucose – 50 mM, EDTA, pH 8 – 10 mM) followed by the addition of 2 mg of lysozyme and incubated at 37 ºC for one hour.

SDS was added to a final concentration of 2 % and mixed vigorously and 100 µl of 5M NaCl was added and mixed. Mixture was left at 20ºC for 10 min. The mixture was then centrifuged at 12000 rpm for 5 min and to the supernatant, equal volume of phenol: chloroform (1:1) was added and the contents were mixed well and centrifuged at 12000 rpm for 5 min. DNA was re-suspended in 0.1X TE buffer for further use (Perumal, *et al.,* 2009).

The extracted DNA samples were quantified using Spectro UV - VIS double beam PC Scanning Spectrophotometer (Model: Labomed, UVD – 2950). Reaction mixtures of 25 µL were prepared for PCR. Each 25 µL reaction volume consisted of 12.5 µL of 2x PCR Master mix (Dream Taq Green of Life Sciences), 2.0 µL of 10 µM forward primer, 2.0 µL of 10 µM reverse primer, 5 µL of DNA template and 3.5 µL of nuclease free water. For the PCR amplification of cyanobacterial DNA, seven primer sequences were used (Table 2). Lambda DNA (λ DNA) with specific primer pairs designed to amplify a part of the λ DNA. PCR was performed in Veriti Thermal Cycler (USA) with initial denaturation temperature of 94 ºC for 5 minutes, 35 cycles of template denaturation at 94 ºC for 45 seconds, primer annealing at 35 ºC for 45 seconds & primer extension at 72 ºC for one minute and the final extension at 72 ºC for 10 minutes.

Table 2: Primers used for PCR reactions

Primers used with cyanobacterial DNA	Sequence
*Cya781*RA	5’ - GAC TAC TGG GGT ATC TAA TCC CAT T - 3’
*Cya781*RB	5’ - GAC TAC AGG GGT ATC TAA TCC CTT T - 3’
*Cya781*RC	5’ - GAC TAC TGG GGT ATC TAA TCC CTT T - 3’
*Cya781*RD	5’ - GAC TAC AGG GGT ATC TAA TCC CAT T - 3’
*Cya359*F	5’ - GGG GAA TYT TCC GCA ATG GG - 3’

*mcyA*F	5’ - AAA AGT GTT TTA TTA GCG GCT CAT - 3'
*mcyA*R	5’ - AAA ATT AAA AGC CGT ATC AAA - 3'
Primers used with λ DNA	
Ent_Lam_F	5’ - CAA ACT GCG CAA CTC GTG AA - 3'
Ent_Lam_R	5’ - GAC AGG CGA ATC GCA ATC AC - 3'

The PCR products were resolved in 0.8% Agarose gel with 0.5X TBE buffer at 60 V for 2 hours. Gels were stained in Ethidium bromide and the gel profiles were observed in a gel documentation system (Bio - imaging Systems, Model: MiniLumi).

Statistical analysis

Descriptive statistics and Pearson’s correlations between cyanobacterial density and different physico-chemical parameters of water were established using SPSS (version 17.0) statistical software.

RESULTS AND DISCUSSION

Dynamics of cyanobacteria

Bottom and the water column of each reservoir had been always changing with the changes of the environment and weather parameters. The correlation analysis revealed that a strong positive correlation existed between the pH of the water in the study reservoirs and the cyanobacterial density (Tables 3 and 4). The highest cyanobacterial density was observed at a pH range of 8.00 – 8.50 (Table 5 and 6). This result is in line with the findings by Soumati *et al*., 2005 in Cheffia dam in the North-East of Algeria.

Table 3: Pearson’s correlation coefficients between different parameters of water in Nuwara wewa

	Cyanobacterial density	pH	Temperature	Water Level	Turbidity	Dissolved Oxygen
Cyanobacterial Density	1.00	0.69*	0.65*	-0.67*	0.67*	-0.54
pH	0.69*	1.00	0.67*	-0.66*	0.57	-0.43
Temperature	0.65*	0.67*	1.00	-0.88**	0.92**	-0.87**
Water Level	-0.66*	-0.66*	-0.88**	1.00	-0.88**	0.85**
Turbidity	0.67*	0.57	0.92**	-0.88**	1.00	-0.93**
Dissolved Oxygen	-0.54	-0.43	-0.87**	0.85**	-0.93**	1.00

*. Correlation is significant at the 0.05 level (2-tailed).

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

Table 4: Pearson's correlation coefficients between different parameters of water in Nachchaduwa wewa

	Cyanobacterial Density	pH	Temperature	Water Level	Turbidity	Dissolved Oxygen
Cyanobacterial Density	1.00	0.68*	0.74**	-0.85**	0.85**	-0.61*
pH	0.68*	1.00	0.56	-0.77**	0.67*	-0.40
Temperature	0.74**	0.56	1.00	-0.84**	0.86**	-0.93**
Water Level	-0.85**	-0.77**	-0.84**	1.00	-0.94**	0.74**
Turbidity	0.85**	0.67*	0.86**	-0.94**	1.00	-0.77**
Dissolved Oxygen	-0.61*	-0.37	-0.93**	0.74**	-0.77**	1.00

*. Correlation is significant at the 0.05 level (2-tailed).

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

Temperature also had a strong positive correlation with the cyanobacterial density within a particular range (Tables 3 and 4). It was stated that the presence of toxic cyanobacteria correlates with a moderate temperature (15 – 30 ºC) (Prentice, 2008). However, the cyanobacteria density and the dissolved oxygen in water exhibited a modest negative correlation (Tables 3 and 4). Bloom of cyanobacteria and their elevated biological activities may be depleting the available dissolved oxygen in water. Temperature, pH and dissolved oxygen can therefore be used good indicators to evaluate the condition of a water body in terms of cyanobacterial density and distribution. In both reservoirs, the cyanobacterial density diminished with the increase in water level. This may be due to dilution of the cyanobacterial population as well as the unfavorable condition of water in the reservoirs for cyanobacterial proliferation.

Table 5: Temporal dynamics of physiochemical parameters of water in Nuwara wewa

Month	Avg. Density ($x10^3$)	Mean pH	Temperature (ºC)	Water level (feet)	Turbidity (NTU)	Dissolved O_2 (mg/L)
January	0.17	6.96±0.07	27.5	9	3	12
February	0.33	7.21±0.09	28	9.5	2	11
March	0.08	7.34±0.02	28	9.5	2	11.5
April	0.25	7.78±0.09	30	8	2.5	10
May	0.08	7.09±0.18	30.5	5	5	10
June	0.17	8.36±0.09	31	1	6	8.5
July	0.92	8.35±0.11	31	-1	7	7
August	2.08	8.35±0.12	33	-2	10	5.5
September	1.25	8.78±0.09	33	-1	12	4
October	0.42	7.10±0.23	31	-1.5	8	4.5

November	0.08	7.22±0.27	32	3	8.5	5
December	0.08	6.71±0.04	29	8	5	8

Chorus and Bartram (1999) stated that when temperature, light and nutrient status are favorable, surface water may host increased growth of cyanobacteria. The period from July to September was a dry spell and the temperature was also slightly high, favoring the proliferation of cyanobacteria. Toxic cyanobacteria produce cyanobacterial toxins like microcystin during high growth and metabolism (Ye, et al., 2009). Therefore, measures should be taken to reduce the cyanobacterial population or completely eliminate them during this period.

Table 6: Temporal dynamics of physiochemical parameters of water in Nachchaduwa wewa

Month	Avg. Density ($x10^3$)	Mean pH	Temperature (ºC)	Water level feet	Turbidity (NTU)	Dissolved O_2 (mg/L)
January	0.25	6.88±0.12	27	10	5	11
February	0.25	7.10±0.09	27.4	9.5	3	12
March	0.17	7.20±0.09	28	9.5	2	11.5
April	0.08	8.04±0.16	29	8	7	10
May	0.17	7.03±0.13	29	5	8	10
June	0.42	8.65±0.11	30	1	10	8.5
July	1.50	8.41±0.20	31	-3	12	6.5
August	2.92	8.36±0.13	33	-5	18	5
September	2.08	8.89±0.08	33	-1	12	4.5
October	0.83	7.59±0.30	31	2	10	4
November	0.17	7.01±0.13	32	4	9	5
December	0.08	6.44±0.16	30	9	6	7

Morphological identification of cyanobacteria

In most of the eutrophic and hypertrophic lakes, *Microcystis*, *Planktothrix* and *Anabaena* are the major microcystin producing cyanobacterial genera (Carmichael, 1994; Carmichael and Falconer, 1993; Chorus and Bartram, 1999, Fleming and Stephan, 2001and Ye., *et al.,* 2009). According to the standard identification keys, many of the isolates recovered in this study were identified as *Chroococcidiopsis* and *Cylindrospermopsis* isolates through microscopic observations. Magana-Arachchi and Wanigatunge (2013) also revealed the prevalence of the genus *Chroococcidiopsis* in waters in the dry zone of Sri Lanka.

Molecular identification of toxic cyanobacteria

The classical method for examination of cyanobacterial taxonomic composition is based on the use of an inverted microscopic analysis of cyanobacterial samples (Bukowska *et. al*., 2014). However, it is

impossible to distinguish potentially toxic and non-toxic strains of cyanobacteria solely based on phenotypic traits. Therefore, use of molecular methods becomes indispensable for this purpose. Molecular methods are now widely used in environmental studies and they support the assessment of taxonomic composition of cyanobacteria and also the identification of toxic cyanobacteria that possess *mcy*-gene cluster in their genome (Bukowska *et al*., 2014). Therefore, DNA amplification of 16S rRNA gene and *mcy*A gene was performed using PCR to identify toxic cyanobacteria at molecular level.

The results revealed that most of the isolates recovered from Nuwara wewa and Nachchaduwa wewa produced PCR products of ~450 bp length with 16S rRNA gene specific primers (Figure 1). In a separate study, Magana-Arachchi and Wanigatunge (2013) also obtained a unique PCR product of similar size in a PCR reaction with cyanobacterial genomic DNA and cyanobacteria specific oligonucleotides as used in the present study. No band was observed for the isolate NUW1 with *Cya*RA + *Cya*F primers though all the other primer combinations yielded either clear or little faint bands (Figure 1). This may be due to any mutation in the annealing site of the gene for these primer pairs or low concentration of DNA in the sample used for PCR.

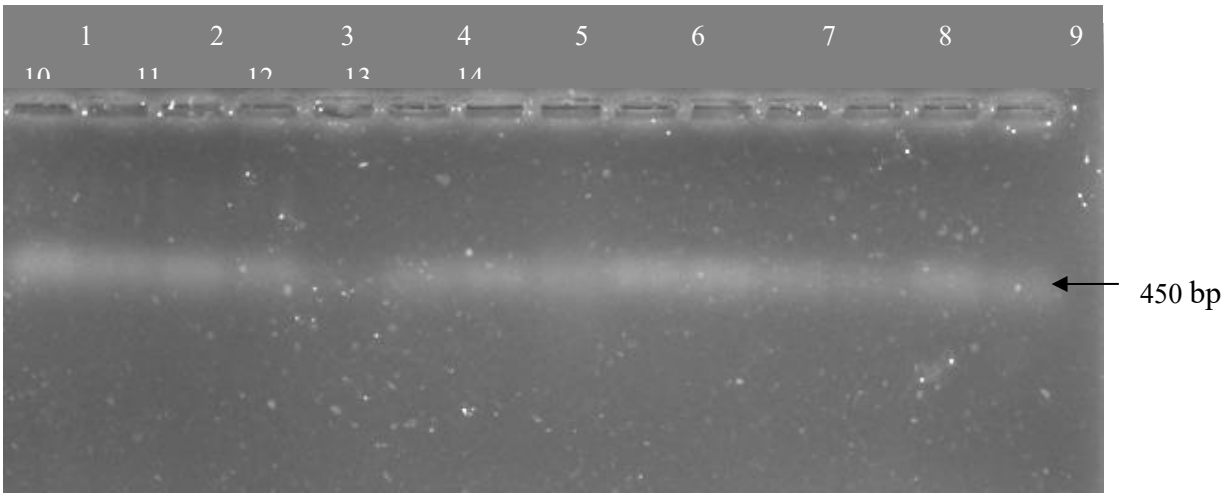

Figure 1: Agarose gel profile of PCR amplified products of the samples 1, 2, 3 and 11 with rRNA gene specific primers

Lanes 1-4: NUW 11, 5-8: NUW 01, 9-12: NUW 02, & 13-14: NUW 03

Lanes 1,5,9&13: CyaRA + CyaF; Lanes 2,6,10&14: CyaRB + CyaF; Lanes 3,7,&11: CyaRC + CyaF; Lanes 4,8&12: CyaRD + CyaF

Although several phycologists have used the 16S rRNA gene for the identification and phylogenetic studies of cyanobacteria, the identity of 16S rRNA sequence data is not sufficient for establishing species identity. Therefore, researches have increasingly moved into 16S-23S internal transcribed spacer (ITS) region (Boyer *et al*., 2001). The ITS is a fragment located between the 16S and 23S rRNA genes. It possess greater degree of sequence heterogeneity that 16S rRNA sequence and therefore permit many genera of

cyanobacteria to be distinguished (Janse *et al*., 2003). However, the present study was aimed at assessing the presence of toxic cyanobacteria and therefore, the 16S rRNA gene was targeted.

Many species of cyanobacteria can produce toxins such as hepatotoxins, neurotoxins and dermatotoxins. Fresh water cyanobacteria belonging to the genera Microcystis, Anabaena, Dolichospermus, Planktothrix and Nostoc produce hepatotoxins known as microcystins, which are the most common yanobacterial toxins in fresh waters (Sivonen and Jones, 1999). The aquatic cyanobacterial community can comprise both toxic and non-toxic strains of cyanobacteria. The presence of *mcy*-gene cluster correlates with the production of cyanobacterial toxins (Pearson and Neilan, 2008). The *mcy*-gene cluster contains seven genes such as *mcy*A, *mcy*B, *mcy*C, *mcy*D, *mcy*E, *mcy*G, and *mcy*I (Christiansen *et al*., 2008). Therefore, *mcy*A gene specific primers were used to check the presence of toxic cyanobacteria as the presence of this gene shows potential microcystin producers (Hisbergues *et al*., 2003).

In the present study, the isolates, which showed positive results in a PCR with 16S rRNA gene specific primers, were subjected to PCR with *mcy*A-gene specific primers. Only a few isolates (NUW 11, NUW 02 and NCH 09) revealed to produce a PCR product with a size of ~300 bp with *mcy*A-gene specific primers. Very faint bands were observed in the Agarose gel (gel photo is not included). This is in line with the finding that Hotto *et at*. (2007). They obtained *Microcystis mcy*A sequence with the size of 291 bp. Richardson *et at*. (2007) revealed in a separate study that direct sequencing of the *mcy*A gene using the *mcy*A-Cd 1F primer yielded partial sequences of 267 and 285 bp for *M. aeruginosa* and BBD *Leptolyngbya*, respectively. This clearly shows that the study reservoirs harbor a few strains of toxic cyanobacteria. However, denaturing gradient gel electrophoresis analysis of PCR amplified ITS regions with sequencing of the same and the mcyA gene are important for further assessment of the presence of toxic cyanobacteria and their identification to species level in these reservoirs. Moreover, proper mechanism should be implemented to get rid of the toxic cyanobacteria when their growth is elevated unsure cyanobacteria-toxin-free water for domestic use.

CONCLUSION

Cyanobacterial density had strong positive correlations with some physico-chemical parameters such as pH, temperature and dissolved oxygen in Nuwara wewa and Nachchaduwa wewa. These parameters can be used as good indicators to assess the status these reservoirs in terms of cyanobacterial density and distribution. Some cyanobacterial isolates recovered from both reservoirs harboured mcy-A gene, showing the potential for microcystin production. However, denaturing gradient gel electrophoresis analysis of PCR amplified ITS regions with sequencing of the PCR amplified product and the mcy-A gene are important to further assess the presence of toxic cyanobacteria and their identification to species level.

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