

# **PEDAGOGICAL APPROACHES TO TEACHING ENVIRONMENTAL HAZARDS IN SUB-SAHARAN AFRICA**

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## ABSTRACT

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Environmentally responsive Education has been identified as a major way through which knowledge about the environment is imparted to students so as its desirable behaviours. Environmental hazards as an area within Environmental Education does not only orient students on causes and effects of negative practices that ruin the environment but also position them in a way that makes the application of such acquired knowledge beneficial to their societies. It is in this light that the knowledge, behaviours and pedagogical processes designed for students of Sub-Saharan African: A Sub-region that has hugely been hit by the adverse effects of Environmental hazards such as Desertification, Deforestation, Climate Change, Indiscriminate Waste Disposal Flood and Drought among others were assessed. An empirical study was however conducted among upper secondary school students with an average age of 17 of this area under study. Data was collected from 100 students from South Africa, Kenya, Nigeria and Ghana with 25 students representing each of the countries using a survey questionnaire. The results show a high correlation between Pedagogy and Knowledge while there was generally a marginal correlation between Knowledge and Behaviours. It was evident however that there is an appreciable degree of gap between students' knowledge on environmental hazards and how practical this knowledge is intended for. It has therefore been suggested that the pedagogical processes in teaching environmental hazards be focused on the interrelationship between the knowledge and the practical behaviours which emanate from it.

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## **1. Introduction**

The notion of environmental education has been explained as how man and the world strategize and implement ways and techniques to sustain and preserve the environment through knowledge (Roth 1992, Harvey 1976 and Orr 1992). Human lives are affected directly and indirectly not only by our immediate surroundings but also by global events through our daily interactions with the environment. Human behaviour, actions and inactions take place in the spatial environment daily and as such result in many alterations which may pose dangers to living things like plants, animals and all facets of human lives especially on vital areas as health, development and standard of living. Over the years, there have been lots of studies, scientific and empirical evidence emanating from researches which show how our world have negatively been affected by the daily happenings from humans. Sourcing from domestic, industrial, group and individual practices and attitudes, the major components of our planet (lithosphere, atmosphere, hydrosphere and biosphere) have all received their adverse share of environmental setbacks.

This cyclical phenomenon should be of great concern to the world with regards to how best the world and any people in any geographical area prepare against the negative effects of the environment. This preparation should be a wholistic approach aimed at bringing everyone on board, regardless of age, sex, race, economic status, just to mention but a few. In recent times, environmental issues have been widely discussed, which has made international agencies, governments, institutions and individuals implement deliberate measures to find solutions to these challenges. Issues like climate change, pollution, global warming, desertification, deforestation, land degradation, among others, have become extremely topical in our time.

There has been a major change on world environment due to the extraction of natural resources, disposal of waste and the depletion of the biosphere which are some of the outcomes of the daily and ever-endless activities of human especially at domestic and industrial levels. Some of the major and vital global environmental setbacks include climate change, waste disposal, biodiversity depletion, accessibility for everyone to good sanitation and providing portable water. Costs of not taking significant measures by the world to handle air pollution alone have sharply ascended taking into consideration the impacts this situation have had on human's health like respiratory related illnesses and

high economic costs of production being it primary, secondary or tertiary economic production levels (OECD, 2008).

In as much as this issue is globally discussed, its negative effects seem to be on a sharp rise in certain areas of the world with Sub-Saharan African countries as no exception. Sub-Saharan Africa is a Sub-region which is characterised by diversity in climate, vegetation, ecology, cultural and other physical features (NASAC 2015). In 2013, the Department of Economic and Social Affairs of the United Nations estimated that by 2050 and 2100 the current population would approximately reach 2 billion and 4 billion respectively. Every 1 in 4 people in this region is undernourished which contributes significantly to about one-third of the population of that world who are undernourished (FAO, IFAD and WFP 2014). The underachievement of potentials for agricultural production has partly accounted for this coupled with the issue of inadequate water (Mueller et al. 2012). Due to inadequate food over 150,000 people die and almost 5 million people are infected with illnesses which are attributable to climate change phenomena like, deforestation, global warming desertification, drought and floods. This phenomenon has not only affected the Sub-region in terms of health but economically, it has impacted negatively on cost of production, availability of raw materials for industries and most importantly cultivation of crops for domestic consumption. The most worrying aspect of this situation is the increasing levels of depletion of the vegetation, illegal and or inappropriateness in extraction of minerals from the land, unlawful invasion of fishing waters, among the rest. The situation seems to increase as days go by.

All these issues cited above could, in one way or another, be attributed to the numerous environmental hazards in the Sub-Saharan Africa. One key area that could help raise awareness, among the younger generation, is undoubtedly through education. Krnel and Naglic (2009), explain that, environmental literacy is the major asset that environmental education offers as it combines knowledge, awareness and environmentally acceptable attitude and behaviour. Through the school, environmental education serves as the bridge between knowledge and behaviour, it focuses on how knowledge about best practices towards the environment is gotten through content and their related practical behaviours. Environmental education is a broad area which tackles several issues about the environment. One of the key areas is environmental hazards. Having the knowledge and being aware of the causes, effects and control measures of issues like pollution,

deforestation, droughts, floods, improper waste disposal among others is of an indisputable essence in our quest to safeguard our environment. Hence the school should be one of the key facilitating avenues in the process of protecting our planet.

The researcher noted prior to the structuring of the statements which were used in the gathering of the data for this study that although these respondents are active going students, they are involved in several primary economic activities to support their education and to make ends meet which is legal in all the countries used for this research. Some students support their families after school, on weekends and most especially during vacation while others do it on their own. It is however based on this first-hand experience and related readings that the questionnaire statements were carefully crafted.

Therefore, this research focuses on how Environmental Hazards as a theme within Environmental education is handled in schools in Sub-Saharan Africa with respect to what the students learn and how they behave. With the researcher's experience in Sub-Saharan Africa extending more than three decades, coupled with the current outcry regarding environmental degradation of this vegetation-endowed geographical area by the UN, World Bank, African Union, various governments and other non-governmental agencies, it is crucial to conduct a research into the pedagogical role of environmental education with regards to knowledge and behaviour targeting environmental hazards as a topic.

### **1.1 Aim of the study**

To tackle environmental issues in Sub-Saharan Africa properly, it is important to consider how well the younger generation understands the issues, challenges, prospects and other related aspects in a broader context. This could be done by targeting how the youth of school-going ages are well oriented. Although there are several outlets around the child such as the media, the family, laws, customs and conventions, it is important that the school is identified as a powerful agent which can easily create the platform for a result-based environmental education to be championed. Therefore, the aim of this research is to:



- ❖ Assess the perceptions of students in Sub-Saharan Africa about the knowledge they have acquired on Environmental Hazards and the relationships it has with their behaviours.
- ❖ Establish the relationship between the perception of students on pedagogical approaches which their teachers have used in Environmental hazards lessons and their knowledge and behaviours that have emanated from it.

## **1.2 Significance of the Study**

This research would be of immense use to numerous organizations concerned with environmental issues, governments and non-governmental agencies especially those related to Sub-Saharan Africa. The researcher also hopes that this study will inform educators and teachers on how environmental issues have been handled in schools and how it has influenced the knowledge and behaviours of their students.

The researcher believes that this study will attract attention and educate people who will then pursue programmes at universities, colleges and environmentally related educational institutions that are related to the environment.

Finally, this research will serve as reference material for other researchers investigating into environment related issues in the world with special emphasis on Sub-Saharan Africa which will serve as a guide and vital information to what is happening on the ground.

## **2. Literature Review**

It has always been a matter of not only a compulsory academic practice but also an incontestable aspect of such a research to be associated with what others have already said in relation to what is being done. Environmental Education has been one area scholars and researchers have been keen mainly because the negative effects of environmental hazards affect every human. It is because of this that the review of related literature of this work was organized under the following sub-headings; Environmental Hazards, Sub-Saharan Africa, Environmental Education, Knowledge and Behavioural Related Environmental Education, Pedagogical Approaches and Conceptual Framework.

## **2.1 Environmental Hazards**

The term hazard connotes any substance that has a high probability to harm or adversely affect the health of living things. Primarily, any substance or phenomenon that could cause harm to the health of people, animals, the environment and or damage to property or equipment could be termed as a hazard. (Chemical Factsheet 2010).

Environmental hazards therefore are the natural and artificial alterations and the daily outcome of interactions between humans and their surroundings that pose a dangerous health effect to humans, plants and animals.

According to the Department of Geography at the University of Bayreuth, the changes that occur in the environment from domestic to global in any form is of crucial significance to the planet. Additionally, aside from climate change, modern environmental challenges such as soil degradation, increase in mass movement and changes in biodiversity has added to the already existing ones. Water pollution, desertification, drought, deforestation and all the major forms of hazards are in no doubt related to the above outlined assertion. The interactions of humans in the spatial environment however are of a great contribution to the above claim and needs to be thoroughly scrutinized. Although the side effects of environmental hazards focus primarily on the health of living things, it goes beyond affecting economic growth, cost and standard of living, safe travelling, settlements and many more.

## **2.2 Sub-Saharan Africa**

Sub-Saharan as the name implies is the African region which lies below the Sahara Desert of North Africa. Its vegetation is naturally dominated by tropical rainforest coupled with some areas of grassland with scattered trees. This region is traditionally noted for the effective cultivation of forestry and plantation crops, grains and cash crops and irrigated crops. Unfortunately, the adverse effects of environmental hazards seem to be hugely affecting this prospect. For instance, the 2010 World Bank report on the Climate Change suggests that production in Agriculture in this geographical region has become susceptible to the adverse imprints of Climate Change with rain dominated agriculture which accounts for about 96% of total crop production being affected. Water security is

being threatened due to its high demand and this threat is exacerbated by climatic change's adverse effect on river runoff, adding to an increase in the demand for irrigation water, which poses danger of groundwater pollution because of high downpour (MacDonald et al., 2009).

In the past 10 years, the savannas have been hugely hit by the encroachment that have occurred on woody plants as suggested by Buitenwerf (2012) and Ward (2005), a situation which is gradually turning huge lands into semi-deserts. Woody plants (plants that are usually trees, shrubs, or lianas) are normally not helpful for domestic livestock but due to an increase in the depletion of forests and vegetation lands, it remains the only option available for many livestock farmers.

Additionally, Wigley and others (2010) have associated the depletion of trees of many places in South Africa to one of the side effects of climate change so as river shortages in Ghana have been broadly attributed to improper mining and land use. Almost every country in the Sub-region has its peculiar and outstanding environmental challenges though there are several which cuts across the whole area.

All these events mentioned above are just a few of the numerous environmental issues that have been widely made public because of environmental studies and research projects in Sub-Saharan Africa by researchers and key agencies.

### **2.3 Environmental Education (EE)**

Environmental education describes the kind of education which includes the infusion of knowledge, skills and attitudes of environmental awareness and practices. It embraces all aspects of instructions which are taught, field trips, excursions and symposiums about the environment in all the stages of education. Environmental education exposes the students to the knowledge about their environment and its associated desired behaviours. Although environmental education takes several forms which may be, advocacies, conferences, media education and through internet, it has been widely discussed that the major avenue where it is pursued is the school.

The 2006 PISA report indicated that the school is the best place children learn very well when it comes to knowing about their environment than any other means or place of

acquiring knowledge. The report further pointed out that, through geography, science and social studies lessons, a great majority of schools provide for their students the most assessable ways through which they learn about the environment. Many subjects may also have certain topics which deal with environmental issues. Some schools also have lessons about environmental studies which are stand-alone in nature. Another avenue that have been proven to give students a lasting understanding is outdoor learning. Field trips, excursions and site seeing are the major outdoor study avenues. Although these activities are common in some countries as their curriculum and time tables gives slots and chance, it is barely non-existent in other countries. In the later countries, there is emphasis on what happens in the classroom. The internet, media, family and friends are also different ways through which students learn outside the school. It has been widely acclaimed that there is the tendency for high achieving students to put together the information they get from the school, the internet and media. Schools are however well-positioned if there is incorporation of environmentally related topics across the other subjects and in extra-curriculum activities and this can end up making students have a desire in environmental topics even outside the school.

In schools, environmental education enriches the student with the knowledge and how conscious the students are towards best practices towards the environment which has sustainability as its uttermost core. As put forward by Hungerford and Tomera (1986), Environmental education should go past just the acquisition of the desired knowledge but rather there are four salient areas which have to be addressed. The first area is the practical knowledge about the environmental, the second is the individual or specific knowledge within this practical knowledge and how to handle them, the third is the ability and competency to make decisions and the last area is the innate affection and qualities that urge people to dedicate more attention to environmental issues.

More recently, Coyle (2005) dwelt on the significance of the awareness by positing that it has got to do with a gradual and systematic ways of bringing a top level of understanding on the main issues and their dynamics which includes skills development and its applicability in a real-world set up. Coyle assigned environmental consciousness to three themes which are basic awareness (just being aware of the pertaining issues), individual design knowledge (being aware of the simple and global concepts) and environmental science proficiency (understanding the basic scientific concepts, the

requisite knowledge to investigate them and how put these concepts into use). The main reason behind Environmental Education however seem to highlight more on the literacy or knowledge and its outcome, which is the exhibition of desirable attitudes or behaviours. Krnel and Naglic (2009) supports this claim by stating that the main underlying reason of environmental Education is the attainment of knowledge, consciousness and acceptable environmentally-friendly behaviours which must all be captured under the broad scope of environmental literacy.

According to Stevenson (1987), The aims of environmental education put together the cognitive practice which analyses environmental phenomena carefully and the establishment of moral regulation regarding such issues. It also includes the interest and the commitment for people to act on their values and principles by giving them access to take active part in the betterment of the environment. The authoritative and popular policy statement which surfaced from the 1975 international conference held in Belgrade and 1977 in Tbilisi confirmed a unanimous acceptance of this fact. For instance, Stevenson explains that the Tbilisi Declaration places emphasis on the student's ability to actively partake in solving environmental problems. This helps them to think critically and acquire problem solving skills in the background of issues regarding quality of life.

Roth (1992), Harvey (1976) and Orr (1992) also add to this claim of the features of environmental education by explaining that it is that knowledge of the functional nature of the world coupled with human's perseverance and sustainability towards the environment. Pedagogically speaking, environmentally related literacy exposes students to the content knowledge and activities which train them to understand the essence of demonstrating a high degree of positive environmental actions and inactions even if they are under no supervision or monitoring.

The school is one of the powerful agents through which knowledge, practices and conventions are transferred from one generation to the other. Undoubtedly, the school's role in ensuring best practices towards the environment cannot be questioned. The 2009 EOCD report on the environment asserts that, Environmental science and geoscience can provide for students their future academic and professional line of work. Most importantly it makes them become citizens who are well oriented in taking individual challenges, among groups and within their societies and these decisions are based on scientific findings about future environmental difficulties. Issues like what students know

about environmental science, what they can do with the knowledge they have acquired and their capabilities of explaining scientific findings and the usage of such findings effectively should always be considered.

Environmentally responsive learning at early stage shapes the way students as future citizens think and interact with the natural surroundings and this reflects in them as they grow to become adults. There is a clear dichotomy between students who are well oriented about their environment than the section of the population who have not or received just a little environmental education. Additionally, the things students learn in school can have a direct influence on their entire home. Just as a supporting claim, students who are knowledgeable about recycling are most likely to change the norm of their entire family (EOCD 2009).

This means that taking a student through an environmental education also influences the behaviour of the people around him as their behaviours serve as a check on others around. Growing to become adults who are environmentally well oriented impacts on the children or little ones around them since in most cases such behaviours are imitated. As deliberations on ways of shaping the behaviour of people and how to mitigate environmental defects keep rising, the duties of the school and its stakeholders are very apt (NSF, 2000).

## **2.4 Knowledge and Behavioural Related Environmental Education**

Knowledge as a theme in environmental education encompasses the totality of content aspect of what the environment entails, acceptable practices so as its sustainability. How to gain this knowledge through school, media and on the internet and its efficacy has been debated by many. For instance, there has been a famous argument that, in the past fifty years the active interdependencies between human and his environment has been the major framework which has taken the centre stage for public policy issues on the importance of environmental science. Even as environmental science becomes complex with modernity many people all over the world find certain key issues quite challenging to understand (Kastens and Turin, 2006; NAS, 2007; Bybee, 2008).

The behavioural aspect of environmental education is simply the desired or required environmental practices which learners exhibit because of what they have learnt. The connection between what they learn and how they behave should always be monitored to be existing than just knowing about the causes, effects and control measure without the mentality that this knowledge is for their practical use. Education faces a tough challenge by not only training environmentalist and scientist but to also offer societies with an equipped, well-informed and self-motivated populace that comprehend and clarify complex and evidence-based theoretical knowledge which would be acted upon (Aini, 2011).

It is in this regard that the outcome aspect of what is being learnt be focused on. Unfortunately, many of the lessons or topics planned under environmental education seem to be geared towards a mere understanding without its extension to the desired behaviours. A pro-environmental behaviour is the one which measures the degree of concern and its related practices towards the environment. As suggested by Krnel (2013), an environmentally good behaviour describes the incorporation of concepts, awareness, values, principles, attitudes, and other societal conventions. Simply put, the attitudes, values and future interactions that students exhibit on the environment are more likely to be the outcome of elements which include awareness, knowledge and social expectations (Bybee, 2005).

According to Courtenay-Hall and Rogers (2002), the space between knowledge and its demonstration about the environment is likely to be a variation of the general space between environmental knowledge and action. This implies that, there is the great need to associate specific knowledge taught in schools to specific desired behaviour. Practical implications and outcomes of specific behaviours should however be made known to students through field trips, outdoor experiences, citing examples from the student's localities and involving them in environmental campaigns and outreach if possible. Krnel and Naglic (2009) supports this by stating that before a rational and knowledge-based deliberation on the causes and effects of human activities about the environment could be achieved it is important to perceive more of what can be done than concentrating on just learning the facts. This approach makes the student sees himself as part and parcel of the whole process of environmental sensitisation and embraces the challenges out there to his

personal level thereby igniting him not to challenge his innermost self alone but the world around him.

## **2.5 Pedagogical Approaches**

If the importance of the school in mitigating the effects of environmental hazards is anything to go by, what students are taught, the preparedness of teachers and how they teach is equally important. Teaching methodologies and strategies are not the same in every field and in every stage of the child's school upbringing. As it has been stated earlier the connection between knowledge and behavior is extremely important in environmental education and environmental hazards for that matter. Instructional planning should be done around this assertion leaving no component either knowledge or behaviour behind.

According to Lovat (2003), Pedagogy may be seen to be an unclear concept, it basically talks about the requisite or essential knowledge and skills which teachers use to carry out successful teaching. Conventionally the term is more understood to be the science and art of teaching which differential the intellectual and social development of students. Other scholars have narrowed their understanding of pedagogy to a specific meaning which is the composition of practical and theoretical understanding of teaching.

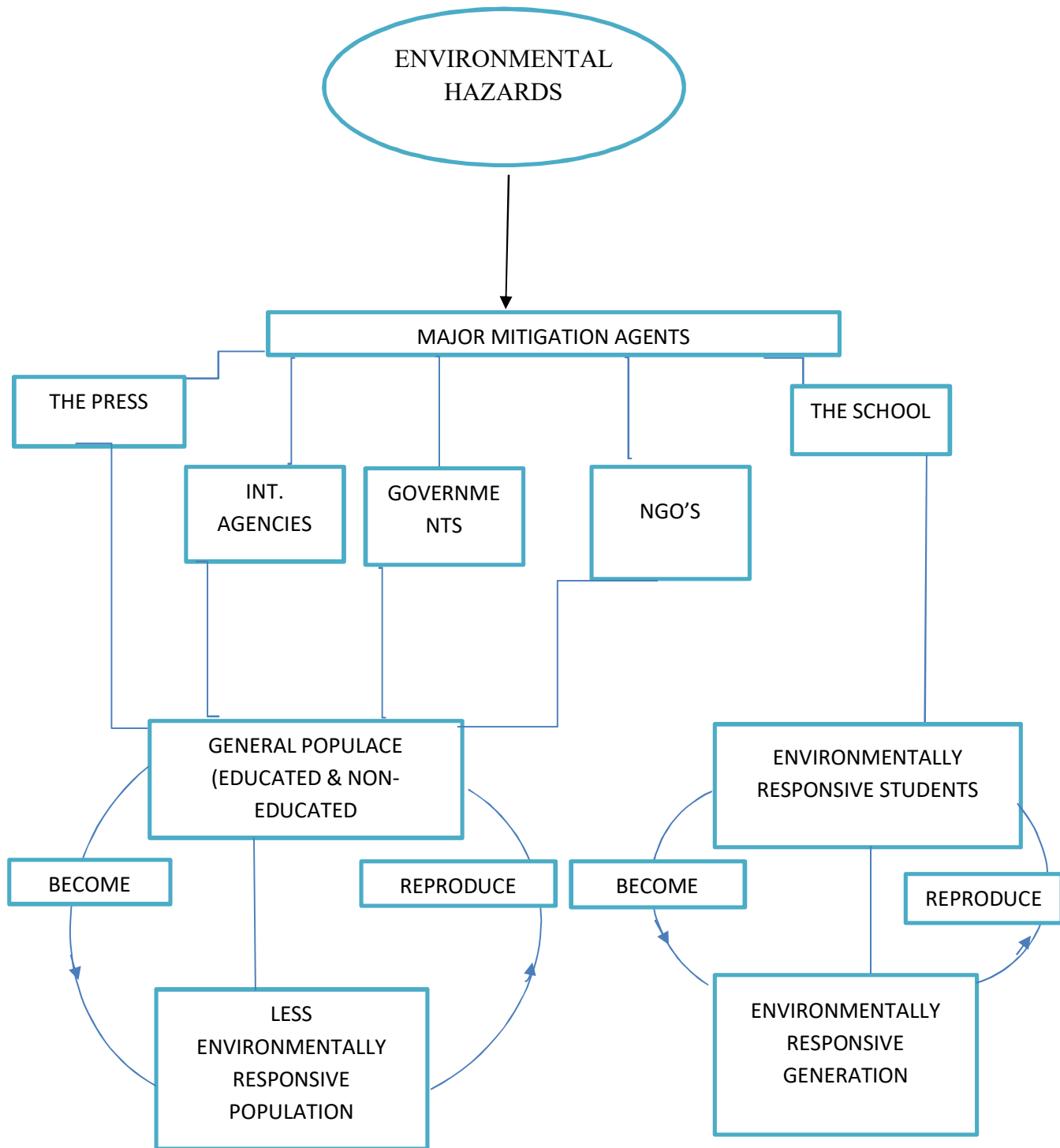
Lovat further states that the teacher is a professionally trained individual with the needed practitioner and knowledge-based skills. Although many researches and findings may support several models of pedagogy, it is the dissension of Freebody and Luke that within a certain scope of policy, different teaching techniques and strategies may vary given that students come from different communities and effective teachers are aware of that (Luke & Freebody 1999).

It has again been argued by Lovat (1999) that teachers who are effective are endowed with deep mastery of the subjects they handle and value how knowledge in their field is created, organised, and how to apply them to a real-world setting, linking them to other disciplines. Teachers acquire critical and analytical thinking about their students when they value to a high esteem the culture and uphold the principles of disciplinary knowledge of all the students. It is in this view of that Atkin (1993; 1997) put across that the intentional use of techniques that trigger a scope of 'ways of knowing' aids students



to have understanding. These 'ways of knowing' is not just about knowing the content but knowing how to behave. It is thus incumbent on teachers and educators to situate environmental education in its rightful context.

## 2.6 Conceptual Framework



**Fig 1. The Underlying Concept Behind the Study**

Figure 1 explains the importance of the school in bringing up environmentally responsive students while other mitigating agencies may sensitise but not give a tangible environmental education in general. As presented by Hungerford (1977), the coming into being of an attitude or behaviour towards the environment starts from the very early years of the individual. If this would hold, through which means would the formation of the said attitude be formed? Except the school which has a set of well-planned curriculum and instructions, all the other agencies do not. It is therefore crucial that what is taught and how it is taught be paid attention to in relation with environmental education. Aini (2011) shares the view that the participation of the younger generation in conserving the environment is significant to their future lives and that of the world.

However, if their education is not hinged on the fusing of environmentally friendly curriculum, such education may target other fields but leave the world in danger. Joseph and others (2004) confirm this reasoning by stating that, when environmental issues turn robust the need to take drastic action becomes more critical, so the younger ones must be armed with the needed skills that are helpful for them in taking good decisions, options and choices.

Per these ideas the importance of the school in environmentally friendly societies is key. It is believed that an educated youth lives with principles and tenets of what they were taught while ensuring that their children are also educated when they are adults. This explains why the cyclical nature of education is a necessity for a less developed region like the Sub-Saharan Africa. The school should be the focus through which environmental hazards would be handled. This demands for a carefully planned and practical curriculum which focuses on methods of teaching the students how to behave well.

Although the media, internet and the experience from home may contribute to desired behaviours, the most effective ways as shown by research is the school. This has been so due to both the immediate and long-term outcomes. Environmentally responsive students affect their generations and generations yet unborn. The Sub-Saharan region just as many places, has been improving in their literacy rate in the past decades. Enrolment levels have risen, teacher to student ratio has increased, number of schools and governments subsidies on education have sharply risen. As compared to other Sub-regions, the positive behaviours of citizens towards the environment started from their great grandfathers and have gotten influence in their societies. Wide educated communities in the olden days

came forth with same and improved societies in modern times. This early environmental consciousness was included in the school settings aside the usual conventional practices from homes. This picture should mirror on the Sub-Saharan African region as the masses are being educated. In many years to come the outcome would be visible and its positive impact felt.

## **2.7 Research Questions**

This research is basically conducted around three areas. The first area is about the knowledge of the students on environmental hazards in general and at the specific level. This is essential because it informs the researcher about the current state of what they know which forms the basis of their daily interaction with the world around them. The second area of the study deals with how teaching and learning has attempted to contribute to the best practices of the students towards the environment. Amongst the other sources of educating the populace on environmental hazards, the role of the school needs to be assessed to ascertain the practical or the behavioural impact it has gotten on the students. It is essential to focus on this since the students are expected to relatively behave better in all facets of life due to their exposure to a well-planned instruction they undergo to be subjected to positive behavioural changes. The last but not the least section also highlights the ways in which pedagogical instructions could help accelerate the decrease in the negative impact environmental hazards pose the environment. Teaching has been identified as a powerful tool which could cause a change in many behaviours. Therefore, these research questions were outlined to provide the basis for this research;

- Has teaching and learning created awareness of environmental hazards among students of Sub-Saharan Africa?
- What has been the role of teaching and learning in the mitigation of environmental hazards in Sub-Saharan African Region?
- In what ways could teaching be used to mitigate environmental hazards in Sub-Saharan Africa?

The first research question aims to bring to the fore the knowledge of the students about the major environmental hazards which are peculiar to the Sub-region which is expected to be thoroughly and efficiently taught. The students' general and specific knowledge on

the hazards Water Pollution, Waste Management, Climate Change, Land Degradation, Floods and Drought would take the centre stage as these are the hazards which the students are direct contributors. Assessing their knowledge would serve as a preserve based on which teaching processes, methods and strategies and its impact on their behaviours would be evaluated.

In other to assess the role of teaching and learning in the mitigation of environmental hazards, the specific behaviours of the students would be assessed. Positive behaviours towards the environment which is because of what students have been taught shows the efficiency of how the teaching was done. Positive behaviours by the students which is not because of what the students learnt in school shows the students have gotten their behaviours from other sources such as conventional practices by the family, media, state regulation and any other means aside from the school. The relationship between their knowledge and these behaviours so as the teaching methods would be analysed to get the true picture of what this research question seeks to put across.

Lastly, it has already been established that fighting the dangerous consequences of environmental hazards cannot be done without the school and for this reason what happens in and outside the classroom which are related to environmental hazards as a topic should also be scrutinized. Best teaching approaches, strategies and methods which the researcher believes should be or become part of the teaching and learning processes in all the stages of especially basic and secondary education would be the yardstick for measuring this.

Another crucial factor which would help with the assessment of the tree themes outlined above is the examination of their inter-relationships. Thus, the relationship between knowledge and behaviour, knowledge and pedagogy and behaviour and pedagogy.

### **3. Methodology**

This study was basically a quantitative one in which a survey was conducted with the use of questionnaire. It consisted of three sections. The first was the Knowledge Component (KC) the second section consisted of the Behavioural Component (BC) and the third was the Pedagogical Component (PC). A similar format was used by Aini et al (2007) and Sharifah et al (2005). KC consisted of 8 questions with each of the question addressing

the major environmental hazards, that is Improper Waste disposal, Water Pollution, Climate Change and Global warming, Deforestation/Desertification, Land degradation/Illegal mining, Floods and Drought. The first question was the only question which an exception and it was sought to address the general knowledge of the students on environmental hazards. This section contains questions on general and specific understanding on environmental hazards with a response format of 5 points Likert scale with (5) as 'Excellent' (4) as 'Good' (3) as Satisfactory, (2) as 'Poor' and (1) as 'Very Poor'. The Behavioural Component consisted of 21 action-based statements in relation to practices towards the environment. These questions or statements were carefully crafted for the specific hazards outlined at the knowledge section. The students were asked to indicate their behaviours with each hazard represented by three statements. A similar 5-point scale was used with (5) as 'Strongly Agree', (4) as 'Agree', (3) as 'Neutral', (2) as 'Disagree' and (1) as 'Strongly Disagree'.

The third component was about what has happened in classroom from primary school to senior High School or the Upper Secondary School in their general, environmental and or social studies classes. The same scale used in the second component was applied here using 15 statements.

The SPSS version 23 was used to analyse the data which was collected. The reliability and means of the questions related to the various hazards were first compared for all the respondents which represented the Sub-region. The same thing was done for all the countries which resulted in the country comparison of the hazards. A Principal Component Analyses (PCA) was run for the data to ascertain if these three factors (knowledge, behaviour and pedagogy) would arise from their response. New Variables were created for the components found which led to the modification of the pedagogy variable in the research and subsequent PCA on knowledge and behaviour, resulted in a division of these variables into two components for each of them, with each component representing a subgroup of the hazards. A reliability test was done for all the variables found which were 5 in number and was followed by a correlation analyses coupled with a comparison of means for all, to determine the relationships between them for all the respondents and for the various countries.

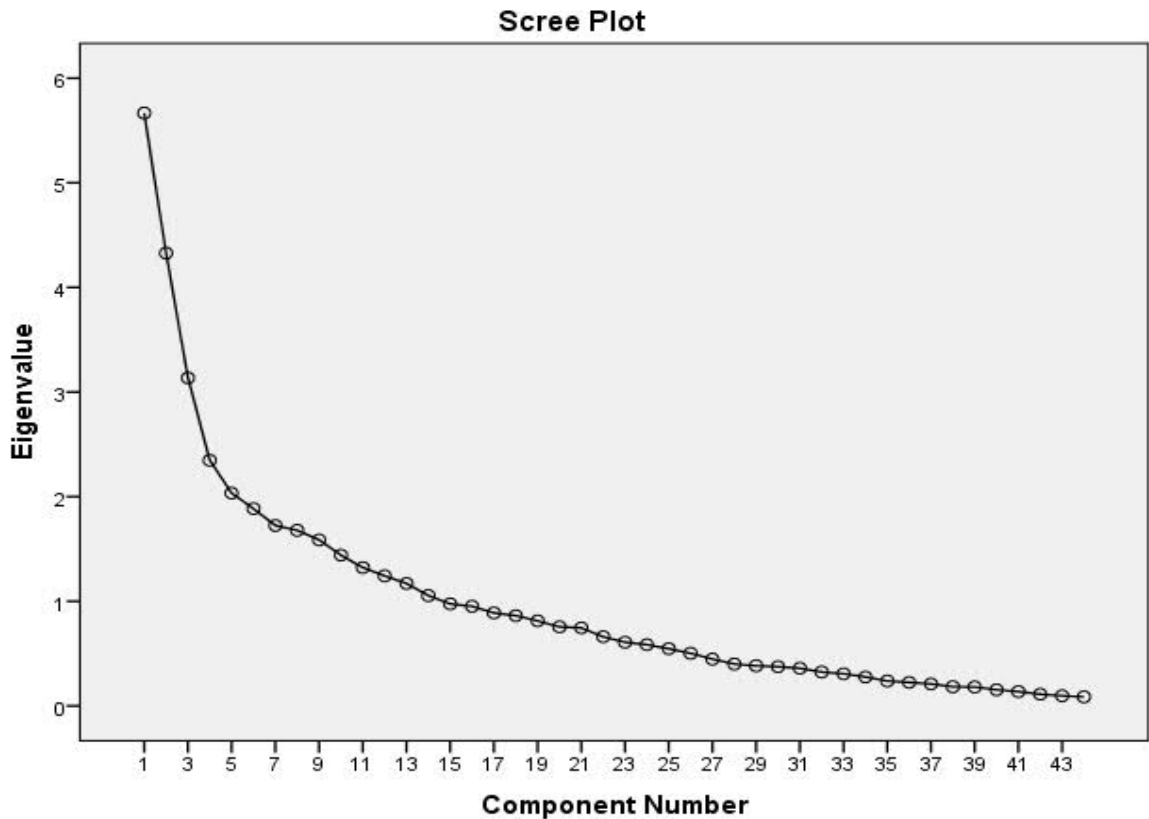
### **3.1 Sampling Population**

The students who took part in this survey were all senior high school students or upper secondary school students with an average age of 17. They were the centre of the study because they have gone through about 11 years of primary and junior high school education and have in various stages of education studied subjects such as Social Studies, Environmental Studies, Citizenship Education, General Studies, Geography and the likes which is supposed to address the many challenges that arise from the relationship between man and his surroundings with environmental issues as no exception.

They were randomly selected from four Countries in Sub-Saharan Africa, which are South Africa, Nigeria, Kenya and Ghana and were a total of 100 with 25 students for each of the four countries respectively. Approval was first received from the heads of schools and the class teachers of the students who were selected before the questionnaire was administered.

## **4. Results**

The Principal Component Analysis from the factor analysis gave 3 distinctive factors which conforms to the sections outlined in the study, that is the Knowledge, Behavioural and the Pedagogy. Judging from the Scree Plot, although these 3 stood out, there were other smaller components which were not deemed to be statistically significant.



**Fig 2. A Scree Plot Showing the Basic Component which came Out from PCA**

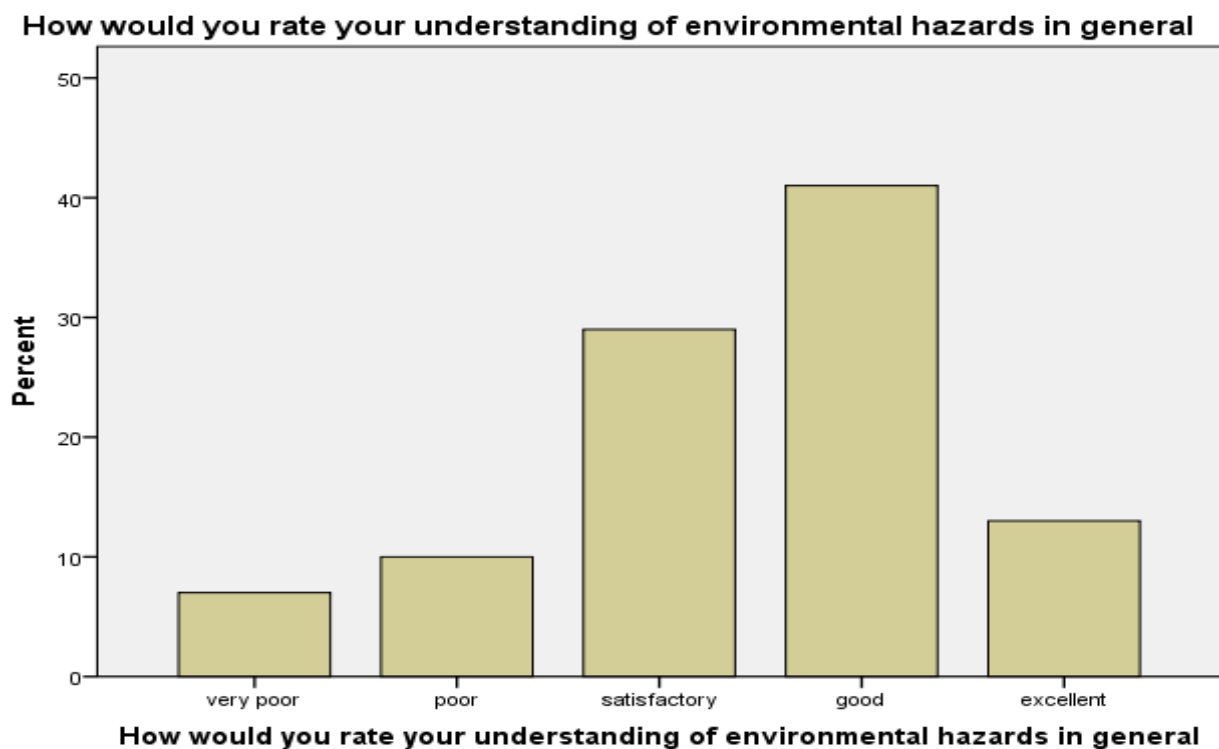
Fig 2 gives the picture of the 3 Components that arose from the Factor Analysis. From the Rotated Component Matrix<sup>2</sup>, the first Component had all the statements under the Knowledge Section of the survey. The second Component had the items under the Behaviour Section of the work. Lastly, the third Component had all the questions under the Pedagogical Section plus some items from the Behaviour section which was further recoded based on the nature of questions from the Behaviour section. The items which made it to any of the components had a significant loading of  $\geq .30$ .

#### **4.1 Knowledge Section**

This section had all the statements which were asked about Water Pollution (WP), Climate Change (CC), Waste Management (WM), Deforestation and Desertification (DD), Land Degradation (LD), Floods (F) and Drought (D) present. The reliability for the statements was ( $\alpha = .85$ ). However, another factor analysis was done which gave two



components under this section. Component 1 comprised of their knowledge on WP, DD and LD and Component 2 was made up of WM, CC, F and D with reliabilities of ( $\alpha = .724$ ) and ( $\alpha = .718$ ) respectively. Variables were created for these Components with the codes K1 as 1 and K2 as 2. The next thing that was done was to examine the students' response about their general knowledge towards environmental hazards to the specific ones. The general understanding of the hazards was also assessed so as the means of the different hazards were compared. Asked to rate their understanding of environmental hazard in general, the bar chart below shows their response.



**Fig 3. A Bar Chart Showing How the Students Rated their General Understanding of Environmental Hazards.**

As depicted by the bar chart, out of the 100 students, 13% said they had an Excellent knowledge, 41% Very Good, 29% Satisfactory, 10% Poor and 7% Very Poor. Simply put almost 50% has a good understanding of environmental hazards in general leaving the other 50% of the respondents rating their knowledge as not so good. However, this does not reflect on their understanding of the individual hazard. Again, there is some slight disparity on the country by country understanding of environmental hazards but not much and for that matter not worth investigating.

## 4.2 The Means of the Various Hazards

In General, the means for the hazards were almost equal around 3.4. This means that the knowledge of the respondents was in-between Good and Satisfactory. WP and DD had the highest means of 3.6 each while Land Degradation had the lowest of 3.1.

**Table 1. A Descriptive Statistics Table showing the Means of the Hazards**

<b>Descriptive Statistics</b>					
	N	Minimum	Maximum	Mean	Std. Deviation
How would you rate your understanding of improper waste management	100	1.00	5.00	3.4000	1.29490
How would you rate your understanding of water pollution	100	1.00	5.00	3.6300	1.17770
How would you rate your understanding of climate change and global warming	100	1.00	5.00	3.4300	.99752
How would you rate your understanding of deforestation/desertification	100	1.00	5.00	3.6300	1.21152
How would you rate your understanding of land degradation/illegal mining	100	1.00	5.00	3.1200	1.22499
How would you rate your understanding of floods	100	1.00	5.00	3.5800	1.21589
How would you rate your understanding of drought	100	1.00	5.00	3.3400	1.04659
Valid N (listwise)	100				

The comparison of the means of the countries showed no meaningful change from the general one in all the hazards. It is worth noting that South Africa had WM with the highest mean of 3.68 and the lowest being LD with a 2.48. Kenya had a different case with WP and CC having the highest means of 3.44 each with Flood as the lowest of 3.08. Nigeria had WP as highest with 4.04 which is the best rated in terms of the knowledge but with LD as the lowest 3.04. Lastly, Ghana had a totally different hazards as its top and least rated. It had the DD as 3.96 and D as 3.24.

## 4.3 Behavioural Section

The questions which made up to the Behavioural Section were first grouped according to the hazards they sought to measure. The means of the hazards were checked to find out

which hazards the students had positive behaviours about and vice versa. This was done for the general respondents and on country basis. The table below shows the Means and Standard Deviations of for the Behaviours for the hazards.

**Table 2. A Descriptive Statistics Table showing the Means of the Hazards**

<b>Descriptive Statistics</b>					
	N	Minimum	Maximum	Mean	Std. Deviation
Waste	100	1.00	4.33	3.0600	.78622
Water	100	3.33	5.00	4.7533	.38670
Climate	100	1.67	5.00	3.5233	.78318
Deforestation	100	1.33	5.00	3.6700	.90204
Land	100	1.00	5.00	4.2233	.78860
Floods	100	2.33	5.00	3.8033	.76555
Drought	100	1.00	5.00	2.9900	.93858
Valid N (listwise)	100				

The Descriptive Statistics shows the means for the hazards according to behaviours. With 1 as “Always” and 5 as “Never”, the activities which led to the above hazards which are spelt out shows that the respondents behave well towards Water Pollution and worst towards Drought. Averagely their behaviours in general was not bad but also not the best which still needs improvement. Again, there were disparities in how the students from the countries behave. South African students behave better in WP with 4.7 but worst on Drought with 2.8. Kenya had WP as 4.6 but WM as 2.4. Nigeria was indifferent about the WP 4.7 being the best behaved with WM as 3.1 as the least. Lastly in Ghana Water had the best of 4.8 and drought as worst as 3.1. This means that the behaviour of students on WP across the Sub-region is “Good” although not Excellent. Their behaviours towards the other hazards however need to be paid attention to and this cannot be done in isolation but in a thorough and well organised way which leaves no single hazard behind.

A factor analysis was done to ascertain the sub-components that are found within the initial behavioural component identified in the first Factor analysis. Two Components were found with each of them having 10 statements and were coded B1 and B2. The first component (B1) had a reliability of  $\alpha=.715$  while the second (B2) was  $\alpha=.714$ . The behavioural items which made the first Component were the statements which were about WP, DD and LD while the second Component had the statements which dealt with behaviours about WM, CC, F and D.

#### 4.4 Pedagogical Section

The Statements which formed this Component were those about the positive teaching and learning methods coupled with some positive behaviours towards the environment. Examples of the positive statements about teaching and learning were; The lessons were linked with what is happening in my communities, I am given enough opportunity to explain my ideas, I am permitted to share my opinions about the topics, I participated actively, during environmental lessons there was a class debate or discussion among others. The positive behavioural statements include, I pay a deliberate attention to products which can be recycled, I use paper for shopping instead of plastic bags, I plant trees along river banks, I take part in cleaning gutters and riverways, I plant trees to replace the ones I cut, just to mention but a few. A reliability test ran for these set of statements was  $\alpha=.79$ . A Variable was therefore created for this component and was named 'Result-based Pedagogy' with the code 'RBP'. The Mean for the pedagogy statements for the Sub-region was 3.4 which also shows a Satisfactory rated performance. The Means of the specific countries were similar with South Africa as 3.6, Kenya as 3.2, Nigeria as 3.5 and Ghana as 3.2.

To have a simplified understanding of how strong or weak the five components were perceived by the students in General representing the Sub-region and the four Countries, the Table below was designed. The Means and Standard Deviations for the five Components representing the Variables used in the research were compared. Reference would also be made from this table at the discussion section of this research.

**Table 3. Means and Standard Deviations (In brackets) of the five variables for the respondents both overall, and for the respective countries**

	<b>GENERAL</b>	<b>SOUTH AFRICA</b>	<b>KENYA</b>	<b>NIGERIA</b>	<b>GHANA</b>
<b>RBP</b>	3.4 (.78)	3.6 (1.0)	3.2 (.72)	3.5 (.72)	3.2 (.60)
<b>K1</b>	3.5 (1.0)	3.8 (1.3)	3.3 (.8)	3.6 (.90)	3.1 (.64)
<b>K2</b>	3.4 (.84)	3.4 (1.0)	3.2 (.73)	3.5 (.81)	3.6 (.84)
<b>B1</b>	4.3 (.52)	4.3 (.64)	4.2 (.60)	4.4 (.51)	4.4 (.31)
<b>B2</b>	3.2 (.70)	3.0 (.80)	2.8 (.60)	3.4 (1.0)	3.6 (.60)

The table above shows the Means and Standard Deviation of the 5 variables used in this study. K1 and K2 were scaled as 1= Very Poor, 2= Poor, 3=Neutral, 4= Good and 5= Excellent. RBP, B1 and B2 were also scaled as 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree 5=Strongly Agree

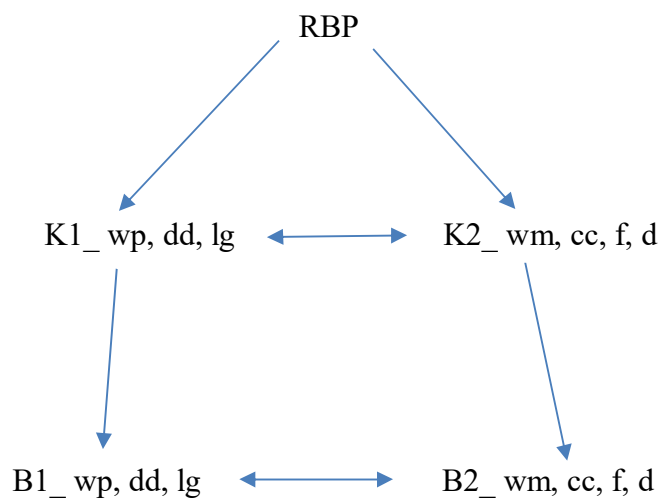
#### **4.5 Correlation Analysis**

After coming into conclusion with these five Variables a correlation analysis was done for them namely K1, K2, B1, B2 and RBP. This was done to examine the relationship that exist between the Knowledge of the students on the hazards, their behaviours and how they are been taught. There was a mapping of K1 to B1 and K2 to B2. This was so because the statements under the B1 were about behaviours towards WP, DD and LD which were the hazards put together and B2 statements were about WM, CC, F, D which made the K2. In order to clearly establish the relationships, a correlation analysis was run for these Variables for the respondents in general and for each country.

#### **4.6 Relationship between results-based pedagogy, knowledge and behavioural measurements**

Apart from the general levels of results-based pedagogy, knowledge and behaviour that are indicators of the education and its outcomes, it is also interesting to look at the

correlations between these variables given that the idea that was put out earlier in this study is that education should not only result in more knowledge, but especially in a field like environmental education, also change behaviour. This implies that it would not only be expected that there are correlations between the knowledge variables, and between the behaviour variables, but also that there are correlations between the knowledge and behaviour variables that relate to the same topics, and between result-based pedagogy and knowledge and to a lesser extent behaviour. The diagram below summarises the expected relationship among the 5 variables.



**Fig 4. A Mapping Outline Showing the Expected Outcome of The Correlation.**

#### **4.7 Correlation Analysis between the 5 variables**

To critically analyse the relationship among the 5 variables, a correlation analysis was done using the expected mapping as the basis. The table shows the level of correlations among all the variables the Sub-Saharan Africa or General level

**Table 4. Pearson correlations between pedagogy, knowledge and behavioural measurements across all countries**

\*is significant at the .05 level, \*\* is significant at the .05 level

		RBP	K1 wp, dd, ld	K2 wm, cc, f, d	B1 wp, dd, ld	B2 wm, cc, f, d
RBP	Pearson Correlation	1	.903**	.887**	.113	-.026
	Sig. (2-tailed)		.000	.000	.264	.798
	N	100	100	100	100	100
K1 wp, dd, ld	Pearson Correlation	.903**	1	.664**	.039	-.091
	Sig. (2-tailed)	.000		.000	.700	.369
	N	100	100	100	100	100
K2 wm, cc, f, d	Pearson Correlation	.887**	.664**	1	.172	.079
	Sig. (2-tailed)	.000	.000		.087	.432
	N	100	100	100	100	100
B1 Wp, dd, ld	Pearson Correlation	.113	.039	.172	1	.197*
	Sig. (2-tailed)	.264	.700	.087		.050
	N	100	100	100	100	100X
B2 Wm, cc, f, d	Pearson Correlation	-.026	-.091	.079	.197*	1
	Sig. (2-tailed)	.798	.369	.432	.050	
	N	100	100	100	100	100

Table 4 shows the correlation results for these correlation across all countries. As it could be anticipated that there is a sizeable correlation (.67) between the two knowledge variables. The correlation between the two behaviour variables, although also significant, it is very minimal. The correlations between RBP and K1 and K2 are extremely high, indicating that those students that perceive their education as Results-Based also report high levels of knowledge in both knowledge areas. This would suggest that efforts aimed at raising students' RBP perceptions could translate into higher levels of knowledge. What can however also be seen from the table is that the relation between knowledge and behaviour is virtually absent in both the k1-b1 and the k2-b2 case. This seems to suggest that education in its present form is not able to establish the connection between knowledge and behaviours.

## 4.8 South Africa

To see how these general patterns are replicated within the Countries used in this research, the same correlation analysis was conducted for pedagogy, knowledge and behavioural variables.

**Table 5. The table below shows the correlation for South Africa.**

\*is significant at the .05 level, \*\* is significant at the .05 level

		RBP	K1 Wp, dd, ld	K2 Wm, cc, f, d	B1 Wp, dd, ld	B2 Wm, cc, f, d
RBP	Pearson Correlation	1	.957**	.963**	.247	-.169
	Sig. (2-tailed)		.000	.000	.234	.420
	N	25	25	25	25	25
K1 Wp, dd, ld	Pearson Correlation	.957**	1	.878**	.179	-.175
	Sig. (2-tailed)	.000		.000	.391	.402
	N	25	25	25	25	25
K2 Wm, cc, f, d	Pearson Correlation	.963**	.878**	1	.248	-.142
	Sig. (2-tailed)	.000	.000		.233	.498
	N	25	25	25	25	25
B1 Wp, dd, ld	Pearson Correlation	.247	.179	.248	1	-.190
	Sig. (2-tailed)	.234	.391	.233		.364
	N	25	25	25	25	25
B2 Wm, cc, f, d	Pearson Correlation	-.169	-.175	-.142	-.190	1
	Sig. (2-tailed)	.420	.402	.498	.364	
	N	25	25	25	25	25

Table 5 indicates the correlation results for South Africa. Mirroring on the correlation for the General respondents, there was a high correlation between K1 and K2 (.88) but no correlation between B1 and B2. However, there was a high relationship between RBP and K1 and RBP and K2 all with (.96) and a disconnection between Knowledge and Behaviour as all the Knowledge variables show no correlation with the behaviour variables. This implies that in South Africa, the students' knowledge about WP, DD and LD, WM, CC, F and D has no influence on how they behave to these hazards. They also perceived that although Results-based Pedagogy plays a role on what they know about hazards but not how they behave towards them also had a role to play on their behaviours about WP, DD, and WM but not for WM, CC, F and D. This gives an indication that there is a lot to be done in the class if the relationship of what they know from what and how they are taught is to impart positively on their daily lives.



## 4.9 Kenya

**Table 6. The table below shows the correlation for Kenya.**

\*is significant at the .05 level, \*\* is significant at the .05 level

		RBP	K1 Wp, dd, ld	K2 Wm, cc, f, d	B1 Wp, dd, ld	B2 Wm, cc, f, d
RBP	Pearson Correlation	1	.911**	.913**	-.112	-.099
	Sig. (2-tailed)		.000	.000	.594	.639
	N	25	25	25	25	25
K1 Wp, dd, ld	Pearson Correlation	.911**	1	.741**	-.179	-.059
	Sig. (2-tailed)	.000		.000	.393	.780
	N	25	25	25	25	25
K2 Wm, cc, f, d	Pearson Correlation	.913**	.741**	1	.069	-.162
	Sig. (2-tailed)	.000	.000		.742	.440
	N	25	25	25	25	25
B1 Wp, dd, ld	Pearson Correlation	-.112	-.179	.069	1	.364
	Sig. (2-tailed)	.594	.393	.742		.073
	N	25	25	25	25	25
B2 Wm, cc, f, d	Pearson Correlation	-.099	-.059	-.162	.364	1
	Sig. (2-tailed)	.639	.780	.440	.073	
	N	25	25	25	25	25

Table 6 shows that the respondents from Kenya had an interesting outcome from the Data. Kenya was indifferent with regards to all the variables having a statistically good relationship to aid in Correlation. There was a high correlation between the Knowledge variables (K1-K2=.74) but had absolutely no correlation with Behaviour. RBP was positively correlated to Knowledge while it had a negative correlation with behaviours. This shows that the knowledge of students in Kenya has no connection with their behaviours towards all the hazards. However, they perceive to what they are taught to have a strong connection with what they know about the hazards but not how they behave. This may partly explain why there is no correlation between the B1 and B2.

#### 4.10 Nigeria

**Table 7. The table below shows the correlation for Nigeria.**

\*is significant at the .05 level, \*\* is significant at the .05 level

		RBP	K1 Wp, dd, ld	K2 Wm, cc, f, d	B1 Wp, dd, ld	B2 Wm, cc, f, d
RBP	Pearson Correlation	1	.901**	.920**	.413*	.456*
	Sig. (2-tailed)		.000	.000	.040	.022
	N	25	25	25	25	25
K1 Wp, dd, ld	Pearson Correlation	.901**	1	.689**	.339	.350
	Sig. (2-tailed)	.000		.000	.098	.087
	N	25	25	25	25	25
K2 Wm, cc, f, d	Pearson Correlation	.920**	.689**	1	.384	.499*
	Sig. (2-tailed)	.000	.000		.058	.011
	N	25	25	25	25	25
B1 Wp, dd, ld	Pearson Correlation	.413*	.339	.384	1	.405*
	Sig. (2-tailed)	.040	.098	.058		.045
	N	25	25	25	25	25
B2 Wm, cc, f, d	Pearson Correlation	.456*	.350	.499*	.405*	1
	Sig. (2-tailed)	.022	.087	.011	.045	
	N	25	25	25	25	25

In the case of Nigeria, there were remarkable indications of the existence of the connection between Results-Based Pedagogy, Knowledge and Behaviour. There was a high correlation between K1 and K2 so as B1 and B2 with (.69) and (.41) respectively although the bond which exist between B1 and B2 cannot be said to be much powerful. It is also worth noting that that the correlation between Knowledge and Behaviour was statistically significant but not as strong as how both did with RBP and it is also far better that South Africa, Kenya and Ghana. RBP also had a positive correlation with K1, K2, B1, B2 with (.90), (.92), (.41) and (.46) respectively. Nigeria showed a highly positive correlation in terms of what the students learn from school, their knowledge about the hazards and to some extent its related positive behaviours. The behaviours of the students which is the result of what they know from school is very encouraging.

#### 4.11 Ghana

**Table 8. The table below shows the correlation for Ghana**

\*is significant at the .05 level, \*\* is significant at the .05 level

		RBP	K1 Wp, dd, ld	K2 Wm, cc, f, d	B1 Wp, dd, ld	B2 Wm, cc, f, d
RBP	Pearson Correlation	1	.710**	.879**	-.386	-.290
	Sig. (2-tailed)		.000	.000	.057	.160
	N	25	25	25	25	25
K1 Wp, dd, ld	Pearson Correlation	.710**	1	.415*	-.455*	-.345
	Sig. (2-tailed)	.000		.039	.022	.091
	N	25	25	25	25	25
K2 Wm, cc, f, d	Pearson Correlation	.879**	.415*	1	-.233	-.146
	Sig. (2-tailed)	.000	.039		.261	.485
	N	25	25	25	25	25
B1 Wp, dd, ld	Pearson Correlation	-.386	-.455*	-.233	1	.390
	Sig. (2-tailed)	.057	.022	.261		.054
	N	25	25	25	25	25
B2 Wm, cc, f, d	Pearson Correlation	-.290	-.345	-.146	.390	1
	Sig. (2-tailed)	.160	.091	.485	.054	
	N	25	25	25	25	25

In Ghana there was a sharp contrast in the relationship between results-based Pedagogy and behaviour. K1 and K2 had a positive but not so powerful correlation of (.42) RBP had a highly positive correlation between K1(.71) and K2 (.88). On the other hand, RBP was negatively correlated with B1 and B2. Their perception indicates that Knowledge had absolutely no relationship with their behaviours. The knowledge of Ghanaian students about hazards from school is very high. Surprisingly they think this knowledge has not impacted on the best of their actions and inactions in school and at home.

## 5. Discussion

The respondents rating their general knowledge was essential to this work since it was informative of their status of the wholistic knowledge they have received over the years on environmental hazards. It was evident per their response that generally 50% rated their knowledge 'Good' with the rest of the 50% as 'Satisfactory' to 'Very Poor'. This however would not be attributed to only the outcome of the school but the media, environmental advocacy, law enforcements and efforts by Governments and Non-governmental agencies.

This effort has not been effective to the fullest since only a section of the students has the desirable knowledge not even to talk of its impact on their behaviours and practical attitudes towards the environment. Asked about their knowledge on the specific hazards, it was deduced that the Means were ranging between 3.1-3.6 out of 5. Meaning their understanding of the individual hazards were just Satisfactory which is an average rating although they seem to have had a better knowledge in Water Pollution and Desertification/Deforestation. In the Case of Water Pollution, the students scored high on Behaviour, but it was not so for Desertification/Deforestation. Although the former gives some good level of connection between knowledge and behaviour, the later shows that this connection is not well established. As evident from the Means and Standard Deviations shown in Table 3, although K1 and K2 were almost scored the same on average, K1's associated behaviour (B1) which represents their behaviours on Water Pollution, Desertification/Deforestation and Land Degradation was highly scored despite the students not feeling very confident that these behaviours are because of their knowledge about them. Aside this general picture the specific countries in contention had their own unique patterns. Kenya and Nigeria had high ratings on Water Pollution, Ghana on Desertification and Deforestation and South Africa on Waste Management.

This may be attributed to campaigns on such hazards and the resources which have been dedicated to each hazard as well as how comprehensive and practical it may receive or vice versa which has accounted for low ratings in Means of South Africa, Kenya, Nigeria and Ghana respectively. Generally, there are no significant differences on how their knowledge on specific hazards in specific countries were rated but it is worth knowing that all their ratings being general and or specific stood at just 'Satisfactory' but not 'Good', 'Very Good' or even 'Excellent'.

In as much as their knowledge is arguably not so bad, there is more to investigate, assess and analyse from this outcome and most importantly how to improve upon it with the School as the agent of change. The contribution of the school would be analysed, and its impact ascertained so as how their level of the knowledge have affected or influenced their behaviours. As quoted earlier, Hungerford and Tomera (1986-87) stressed on the tenets of Environmental education as more of an operational knowledge about topics of the environment, a unique knowledge of strategies and techniques at solving those issues, the capability to choose rightly, and the ownership of useful qualities, values and attitudes which ignite people be passionate and become extremely concerned about environmental conditions. Therefore, any planned Environmental education curriculum and its instruction should be carved around these pillars of knowledge and its associated behaviours.

### **5.1 Behavioural**

In terms of the practical actions and inactions of the students towards the environment, there were slight difference to the ratings compared to the knowledge section. Generally, the behaviour of the students was high on Water Pollution. It was also interesting to note that all the countries had their highest Means on Water Pollution. Except for Land Degradation, the rest of the hazard were moderately Satisfactory for both the Sub-region and the specific countries. The usage of chemicals in fishing, dumping waste in water bodies and defecating into water bodies is on the low in the Sub region. In modern times there has been improvement in portable water projects, toilet and other sanitary facilities.

It could be argued largely that in the last decades the United Nations and Environmentally friendly organizations as well as governments have intensified campaigns and invested more resources into Environmental advocacy which has resulted in this. On the other side of the coin, their behaviour on Land Degradation, Deforestation, Floods and Drought is poor and this shows that indiscriminate cutting down of trees especially along river banks, blockage of waterways due to improper waste disposal just to mention but a few still needs improvement. The sharp growth in population remains a threat as the invasion of the forest lands for settlement and making use of the vegetation as a raw material for building houses and as raw materials for small-scale or family-based industries are still on-going.

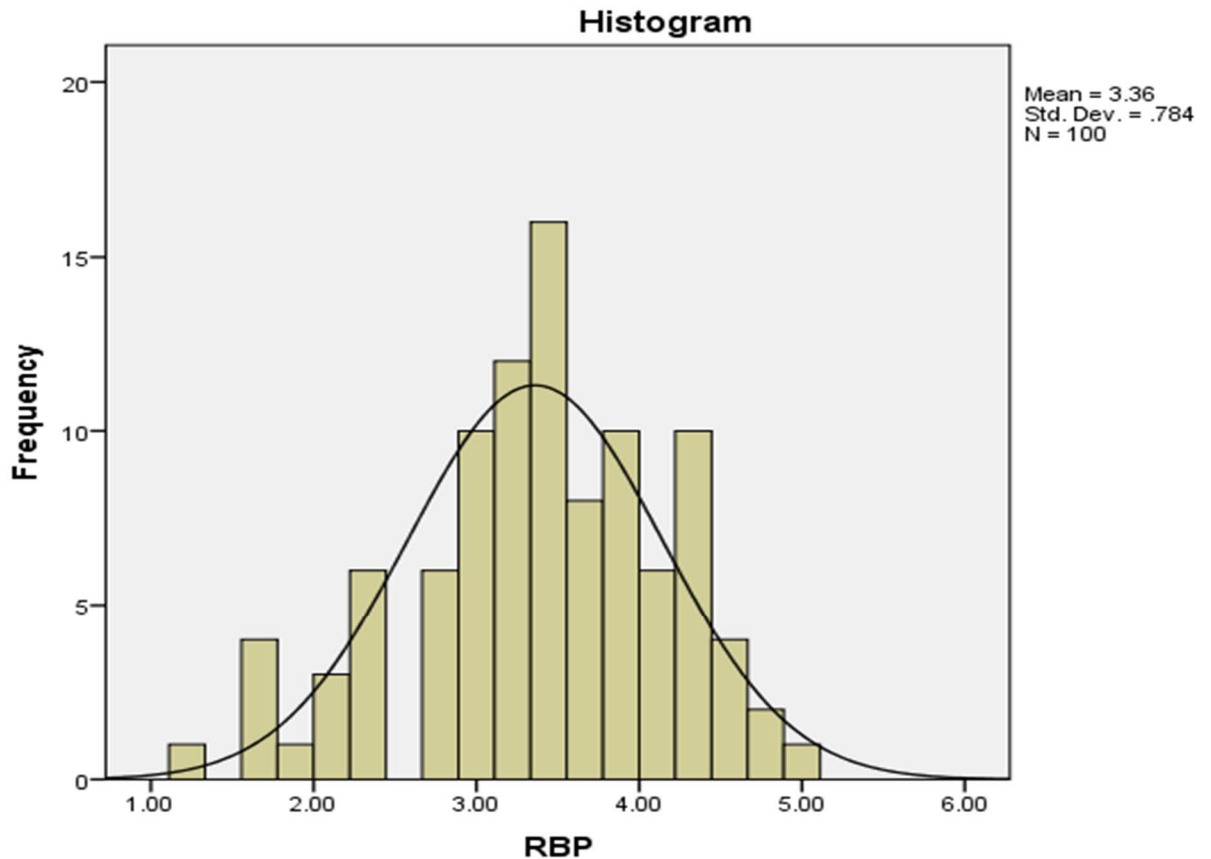
## 5.2 Pedagogy

From the Sub-regional view, teaching as a means of mitigating the effects of environmental hazards and ensuring best practices was just a little above average. This means that there is more work to do with regards to teaching methodologies and strategies. Looking at the means for some specific statements which were related to Pedagogy it was evident that much is being done at least from the students' perspective. With a Scale of 1 as 'Strongly Agree' to 5 as 'Strongly disagree'. The overall Mean of 3.4 shows that statements like; The teachers used practical examples to help students understand the world outside school, There were practical assignments, excursions or field trips during such lessons, The lessons were linked to what is happening in our community, Many different teaching methods were used, Teachers clearly explained the relevance of the concepts to our daily lives and some others though were used, it was not to their applicability. This is a clear indication that these practical teaching methods and strategies need to be improved.

There were other positive statements of the pedagogy which received a high Mean like, 'The teacher uses technological application to show how environmental concepts are relevant, during environmental hazards lessons there a class debate and discussion, I participated actively during lessons and I am given enough opportunities to express my ideas. This perception of the students was done solely on what they have witnessed during environmental classes. The curriculum should therefore embrace all possible content, strategies and techniques which will cause these effects to happen among students. For instance, it has been argued by Stevenson (1987) with reference from other researchers pointing out that the focus of the available curriculum could be said to be a breakdown of complex issues and concepts as well as the rationalisation of disintegrated fields of study.

The most commonly known pedagogical procedure identifies the teacher as a provider of accurate and genuine knowledge. Usually the teacher is the only actor who involves the students in higher order thinking of situations which involves careful observation and examination of learning situations, and the skills to make an acceptable value judgement. Teachers therefore bear the responsibilities of making sure that lessons are always planned and organised strategically to ensure a meaningful change among students.

The histogram below shows how the students rated their perception between 1 and 5 of how results-based pedagogy influences their knowledge and behaviour, with 1 as ‘Strongly Disagree’ and 5 as ‘Strongly Agree’.



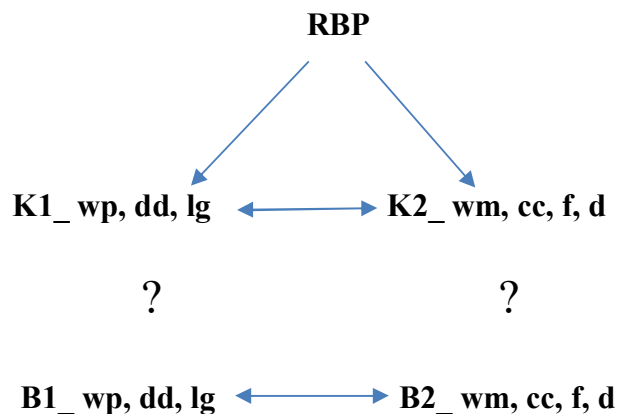
**Fig 5. A Pie Chart Showing the Means of how Students Perceived Pedagogy**

### **5.3 Relationship Between Knowledge, Behaviour and Results-Based Pedagogy**

The correlation analysis was used to determine the relationships found between the three components. As showed by figure. K1 represented the Knowledge of the students on Water Pollution, Deforestation and Land Degradation while B1 represented their behaviours on the K 1 hazards. K2 represented the knowledge of the students on Waste Management, Climate Change, Floods and Drought while B2 represented their respective behaviours towards the K2 items. The fifth component was the results-based pedagogy coded by RBP. The correlation analysis points out that K1 and B1 had a high positive relationship which implies that what the students know about Water Pollution,

Deforestation and Land Degradation had a positive or direct influence on their behaviours.

However, although K2 and B2 were positively correlated, it was very marginal and suggestive of the fact that ways of informing the students on the Knowledge about Waste Management, Climate Change, Floods and Droughts and their related behaviours should be improved. Again, there was a strong connection between RBP and the two knowledge components indicating that the teaching and learning in school plays a vital role on what the students know about these hazards. On the other hand, the connection between what they are being taught in school and their behaviours seem to be on the low. This has created a gap between their perception of what is being taught and their practical behaviours. Teaching therefore seem to be targeted towards the students' acquisition of knowledge but not how it affects their lives practically. That is much emphasis may have been based on the student's achievement in promotion, examination and good grades to pursue higher education leaving the affective domain obsolete or dormant. Curriculum planning unfortunately has not been done to curtail this loop hole. Figure 6.0 gives a pictorial description of the relationship among the 5 variables discussed earlier in this section.



**Fig 6. A Mapping Showing the Correlation Analysis at the General level**

Aside from this general picture which represented the sub region, the four countries had some peculiar patterns though not very great, except for Ghana. This shows that the situation of students' knowledge, behaviour and pedagogical approaches may differ slightly in the over 32 countries in this area under study. In South Africa, Knowledge had an almost no connection with behaviour with K1 and B1 as marginal and K2 and B2 even



as a negative correlation. Pedagogy was very high on their knowledge in all the two components meaning on all the hazards which certifies the close link between what the students knew and their associated behaviours. Results-based Pedagogy versus Behaviours were indifferent from the total picture as there was just an insignificant relationship between RBP and B1 and a negative relationship between it and B2.

In Kenya, the relationship between all the Knowledge components and all the Behaviour components were inexistent which explains that the students may have an appreciable knowledge on these hazards, but it does not reflect on their practical approach towards safeguarding the environment. Again, the analysis suggests that the students perceive what they know about hazards as the positive outcome of their participation of a set of well-structured and organised classroom methods, strategies and instructions. Notwithstanding this good link between Results-based Pedagogy and Knowledge, Kenyan students perceived the RBP to have nothing to do with their practical approach towards all environmental hazards. It appears that the focus of teaching methods, strategies and skills are geared towards letting the students become informative and better in terms of content knowledge but not that which would be useful for their daily lives and for the benefit of their entire communities.

In Nigeria, there was a positive relationship and interconnectivity of the students' perception on Knowledge, Behaviours and Results-based Pedagogy. They suggested that what they know about environmental hazards are because of the pedagogical methods and approaches in school and in turn affects their practical behaviours. This confirms the high Means of Nigerian students on the behaviours towards the hazards. Although this sought to be a good interrelationship it still goes in line with the General and the picture created in other countries of pedagogy having a close link with knowledge. Even though Knowledge and Behaviour correlated well with Results-based Pedagogy, Knowledge had a very high connection than behaviours an indication that what they are being taught have had a very good impact on what they know and how they behave but what they know far outweighs the good environmental practices which were supposed to be the outcome of what they know.

In Ghana, there was a sharp negative relationship between Knowledge and behaviours which gives a great concerned with regards to this huge disparity. Although they perceive their knowledge to be because of their school experience, it is worth knowing that the

knowledge they have gotten from the school was perceived to have absolutely no impact on their behaviours. It has been hugely argued that most teaching and learning environments are organised with the sole motive of assisting the students become knowledgeable in passing their examinations, getting admission into higher institutions but not targeting how applicable these pieces of information and knowledge would be used in the daily lives of the students. It is thus incumbent on policy formulators, curriculum planners, classroom teachers and all stakeholders in the Sub-Saharan African countries to examine this situation and focus on pedagogy that stresses on the link between knowledge and behaviours.

It is evident from the General and specific countries analysis that pedagogy is perceived by the students to have played a vital role on their knowledge about environmental hazards but neither the teachings strategies nor their knowledge had influenced their behaviours significantly except for Nigeria, where there is some level of connection also to behaviour. This exposes the gap between what is being done in schools and how they behaved towards their environment. The table below summarises how the students perceived all the 5 variables for the General respondents to the specific countries.

## **6. Conclusion and Recommendation**

As pointed out in the analysis, there was huge disconnection between Knowledge about the environmental hazards and their desired behaviours. The Means of their knowledge are not so bad which still needs to be improved. Much planning needs to go into preparation of curriculum and given of instructions. Most importantly, attention should be paid to how lessons on environmental hazards are planned and taught with emphasis on how it could influence positive behaviours of the students.

The focus of teaching and learning as being preparing students towards the acquisition of knowledge for examination purposes and a means to achieve higher education should be enriched with that which ensures desirable practical behaviours towards the environment. Stife (2010) explains that, Environmental education has the propensity to train the student as a responsible citizen who has acquired the skills of environmental excellence. It is also to train learners to protect the dilapidating environment and societies which are increasingly becoming unhealthy. This sensitisation is gradually creating public

awareness and motivating a careful formulation of regulations by state or national authorities and for indigenes of any geographical area to rise and act. Above all, the integration of environmental education in the school curriculum which involves both classroom work and outdoor activities would become well embraced.

Moreover, a critical attention should be paid to the pedagogical processes which seek to empower the knowledge of the students over their associated behaviours to fix this gap. Theoretical approaches that are friendlier to the level of the students which will link what they learn to how they may behave should be the emphasis. As (Payne, 2006) puts it, Environmental education should be for the environment but nothing else. This informs the stakeholders in education about the need for project-based pedagogical approaches which emphasises on happenings of the students' local environment.

It is therefore critical that the practical aspect should be considered at any point in schooling. That is why Strife (2010) agrees with Cole, (2007) when he explained that the debate to practicalize how Environmental education is promoted also demands that there is a push for a thorough philosophical coupled with the advancing pedagogical practices which include socio-ecological methods, experiential and place-based learning and modern curriculum theories.

Therefore, a good Environmental Education which gives an in-depth knowledge and its practicality in relation to environmental hazards should not be restricted under just one or two subjects. Especially if they are elective subjects it deprives the students who are not offering such elective courses from understanding these issues under discussion. General and Core subjects should be organised in such a way that they would include not only a shallow or few environmental topics but and in-depth and key ones. In this way no student would be left out in the quest of subjecting and exposing them all to the essential ways of understanding environmental hazards and the practical implications for their lives.

## **6.1 Limitation of the Study**

There were a few challenges associated with this research. The first is the long bureaucratic processes the researcher had to undergo before getting the respondents. In South Africa and Nigeria especially, the initial schools which were chosen had to change

which demanded for another orientation to class teachers who facilitated and collaborated with the research team.

Secondly, there is no standardised curriculum used across the Sub-region which makes comparative assessment challenging. Subjects which contains environmental education topics are not uniform and differ from country to country and even which stage or class these topics are taught.

Additionally, as already acknowledged, this research was basically dependent on the perception of the students. There was no concrete documented data on knowledge and behaviour which was used. It is the researchers believe that such a hard data may have gotten influence on the findings of this work.

Last but not the least, although the respondents chosen were upper secondary students, the data would have been more accurate if they were all exposed to a similar physical and theoretical environment under which their schooling is organised.

## **6.2 Areas for future Research.**

There are very interesting areas about this work that would be worthy of exploring for future researchers. This work sought to combine all the hazards and thus, doesn't delve deeper into them. Pedagogical approaches to teaching the specific hazards or comparative study about them would be interesting.

Moreover, another area is highlighting the behavioural aspect towards environmental hazards. What has accounted for certain behaviours both from school and external agents. Reconciling the causes of environmental hazards from the experience of the students at home and that from school is vital.

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## APPENDIX A

### QUESTIONNAIRE STATEMENTS FOR THE KNOWLEDGE SECTION

1. How would you rate your understanding of environmental hazards in general?

<b>Very Poor</b>	<b>Poor</b>	<b>Satisfactory</b>	<b>Good</b>	<b>Excellent</b>

2. How would you rate your understanding of these specific environmental hazards?

	<b>Very Poor</b>	<b>Poor</b>	<b>Satisfactory</b>	<b>Good</b>	<b>Excellent</b>
<b>Improper plastic and waste disposal</b>					
<b>Water Pollution</b>					
<b>Climate change/global warming</b>					
<b>Deforestation/ Desertification</b>					
<b>Land degradation /Illegal mining Soil erosion</b>					
<b>Floods</b>					
<b>Drought</b>					

## APPENDIX B

### QUESTIONNAIRE STATEMENT FOR THE BEHAVIORAL SECTION

HAZARDS	STATEMENTS TO ADDRESS THEM
<b>Improper plastic and waste disposal</b>	<ul style="list-style-type: none"> <li>• I dispose of used containers, bottles and waste in a waste bin</li> <li>• I dispose of all waste in the same container</li> <li>• I use paper for shopping instead of plastic bags</li> </ul>
<b>Water Pollution</b>	<ul style="list-style-type: none"> <li>• I throw substances into natural water bodies</li> <li>• I urinate and or defecate in rivers</li> <li>• I use chemicals in fishing</li> </ul>
<b>Climate Change/ Global warming</b>	<ul style="list-style-type: none"> <li>• I use bicycle rather than a car</li> <li>• I pay a deliberate attention to products which can be recycled</li> <li>• I take part in bush burning during farming seasons</li> </ul>
<b>Deforestation/ Desertification</b>	<ul style="list-style-type: none"> <li>• I cut down trees as firewood</li> <li>• I burn some of the trees I cut before getting them as wood</li> <li>• I rely on grass and other plants around my environment to feed our farm animals and or pets</li> </ul>
<b>Land Degradation/ Illegal mining</b>	<ul style="list-style-type: none"> <li>• I help people in small-mining of gold and other minerals</li> <li>• I add my litter to a pile of litter on the ground</li> <li>• I am involved in cutting down of trees for domestic activities</li> </ul>
<b>Floods</b>	<ul style="list-style-type: none"> <li>• I throw rubbish and waste products in gutters and waterways</li> <li>• I plant trees along river banks</li> <li>• I take part in cleaning gutters and riverways</li> </ul>
<b>Drought</b>	<ul style="list-style-type: none"> <li>• I plant trees to replace the ones I cut</li> <li>• I use gas and hydro-electric power instead of firewood</li> <li>• I help my parents/guardians plant our own source of food to feed our animals</li> </ul>

## APPENDIX C

### QUESTIONNAIRE STATEMENTS FOR THE PEDAGOGICAL SECTION

- My knowledge about the causes and practical effects of environmental hazards comes from school
- There were practical assignments, excursions or field trips during such lessons
- The lessons were linked to what is happening in your community
- I learnt the lessons for examination purposes
- I learnt the lessons for their practical relevance
- I participated actively
- I was given enough opportunity to explain my ideas
- I was permitted to share my opinions about the topics
- During the environmental lessons there was a class debate or discussion
- I learnt the lessons because of their importance
- Only one teaching method was used
- Many different teaching methods were used
- The teachers used practical examples to help students understand the world outside school
- The teachers clearly explained the relevance of the concepts to our daily lives
- The teachers used examples of technological applications to show how environmental concepts are relevant to the society