UNIVERSITY OF EDUCATION, WINNEBA

SOCIAL STUDIES CURRICULUM AND CLIMATE CHANGE: VIEWS OF TEACHERS' AND STUDENTS' IN SENIOR HIGH SCHOOLS IN BOLGATANGA MUNICIPALITY

FRANCIS NYAABA KAPUSEBA

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FRANCIS KAPUSEBA NYAABA
8180410011

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MARCH, 2021

DECLARATION

Student's Declaration

I, Francis Nyaaba Kapuseba, declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature: ……

Date……..

Supervisor's Declaration

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Thesis as laid down by the University of Education, Winneba.

Name of Supervisor: Dr. Isaac Eshun

Signature: ……

Date……..

DEDICATION

To my late mother Ayerebawo Tiberu Nyaaba, my wife, Mrs. Lilian Ayerezang and my daughter, Annsley Wemanga Nyaaba.

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It would amount to gross ingratitude if I fail to register my sincere appreciation to all those who assisted me in diverse ways to successfully complete the programme. My first thanks goes to the Almighty God, by whose grace I have been able to come this far in my educational journey. I would also like to express my sincere and profound thanks to Dr. Isaac Eshun, my supervisor, whose skills, experience, steadfast guidance and keen oversight saw this work started and completed.

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GLOSSARY

AGW	Anthropogenic Global Warming
CC	Climate change
CDM	Clean development mechanism
CFCs	Chlorofluorocarbons
GHG	Greenhouse gases
IPCC	Intergovernmental Panel on Climate change
MDGs	Millennium Development Gaols
NGO	Non-government Organisation
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework convention on climate change
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children‟s Fund
UNSCO	United Nations Educational, scientific and cultural organization
WHO	World Health Organisation

ABSTRACT

The study sought to examined senior high school social studies teachers‟ and students‟ perceived challenges and responses to climate change in the Bolgatanga Municipality. A mixed method approach was used for the study. A convergent parallel design of mixed methods was employed for the study. A total of 172 respondents were sampled for the study. A purposive sampling technique was used to select 128 students and census survey was used to sample 41 teachers. Questionnaire and semi-structured interview guide was the main instrument for data collection. The data gathered was analysed using the Statistical Product Service Solutions (SPSS version 21) for the quantitative data whilst qualitative data was analysed thematically. Finding from the study revealed that; Social Studies teachers have, to a large extent, irreplaceable knowledge about the meaning of climate change, majority of the students were uncertain with most of the various definitions of climate change; majority of the teachers believed that the Social Studies curriculum addresses climatic issues to a large extent, most of the teachers agreed to all, the following challenges; inadequate TLMs for teaching climate change, unavailable of resource persons, Social Studies curriculum is overloaded with other issues, Abstract nature of the causes of climate change, difficulty in communicating climate change issues to the students, Centralization of the curriculum, inadequate curriculum designers‟ knowledge on climate change, inadequate teacher‟s knowledge on climate change, politicization of the debate on climate change, financial constraint, poverty and finally because the effect of climate change has not been sufficiently yet. It was recommended that Social Studies teachers should constantly revise their knowledge on climate change to continue keeping them abreast with current climatic issues, the National Council for Curriculum Assessment (NaCCA) should consult teachers for their rich knowledge when introducing climate change issues or redesigning the Social Studies curriculum, a workshop should be organized for teachers of secondary schools to enable them have a better understanding to cope with the menace of climate change. This will equip them for classroom delivery.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Climate change has become an environmentally threatening phenomenon. An effective strategy which can help tackle the issue is the concern and action by the human beings who are noted to be the main cause and affected by the problem. Public actions can only be likely where the tendency to behave and response is made more vibrant. However, the presence of poor understanding of climate change poses much more difficulty in explaining and eliciting people‟s expected action and concern to the issue. This can weaken and annul efforts towards adaptation and mitigation.

Climate change has emerged as one of the most devastating global environmental threats (Pandve, et al., 2011). It is a challenge in this present day because of its accompanying changes in weather patterns (Acquah, 2011). This can have serious repercussions for humans, upset seasonal cycles, harm ecosystems and water supply, affect agriculture and food production, and cause sea-levels to rise (Chineke, et al., 2015). Climate change is not an occurrence in the distant future, but a phenomenon that is taking place now (Dankelman, 2002). Many reports abound on how climate change is impacting the planet. The Intergovernmental Panel on Climate Change (IPCC) is the main body formed by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP), to assess the scientific and technical information about climate change in a comprehensive, transparent, and objective manner. The IPCC has stated clearly that climate change is inevitable, it is real and happening now and the impact will be felt globally.

The World Health Organization (WHO, 2003), has indicated that climate change has become a distinctive and significant addition to the range of environmental hazards encountered by humankind. The United Nations (UN, 2010) also observes that global pursuit for sustainable development is under serious threat because of the impact of climate change. There are increasing evidence that suggests that most places in the world will be transformed and lost through the impacts of a changing climate. Urgent action is thus expected of mankind to tackle this danger (IPCC, 2014).

The most recent report (the Fifth Assessment Report) of the Intergovernmental Panel on Climate Change (IPCC, 2013) indicates that society is experiencing one of the worst environmental crises ever witnessed in the Earth‟s history, with increasing global mean surface air temperatures over the last one hundred years. In many regions, changing precipitation or melting snow and ice are transforming the hydrological systems and affecting the quality of water resources. Many terrestrial and marine species have modified their behaviour and activities in response to continuing climate change. These changes have a deepening impact on society, far more than any other environmental changes the Earth has ever witnessed. They affect everyone everywhere on our planet.

Continued global climate change could undermine some of the progress already attained by developing countries towards the Millennium Development Goals (MDGs) of eradicating extreme poverty and hunger, achieving universal primary education, and ensuring environmental sustainability (Pinter, 2013; National Research Council [NRC], 2011; Singh, et al., 2010; Ringler, et al., 2010; United Nations, 2000). It is the view of this study that, if the developing countries are to realise an inclusive sustainable development experience in the anticipated future, policymakers must

begin to consider schools as an agency to produce a climate change-literate population.

Climate change is of variety of effects, such as rising sea level, desertification, extinction of plant and animal species, shifting of agriculture patterns, and changes in the occurrence of extreme weather (IPCC, 2001; Pitpitunge, 2013). The effect of climate change on crop farming may be different from animal production (Masese et al., 2016) such that it may be favourable to one but unfavourable to the other (IPCC, 2007). The change in rainfall pattern had led to a reduction in soil moisture and hence, a disruption of Agricultural sector. Thus, climate change becomes a concern of international organizations and governmental institutions because of its impacts on different sectors such as agriculture, ecosystem and biodiversity (IPCC, 2007). Climate change has resulted in cases of environmental catastrophes in Africa (Ofei-Nkansah, 2013; The World Bank Group, 2013), and Ghana has not been left out of these (Badu-Agyei, 2012; Boadi, 2013; Kunateh, 2013). Global climate change is therefore a topic of major public interest, not only because its impacts will impinge on many areas of our lives but also because a range of options is available to tackle the causes of the problem.

IPCC explains further that climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2013). The United Nations Framework Convention on Climate Change (UNFCCC) also defines climate change as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over

comparable time periods" (UNFCCC, 2001). The UNFCCC thus makes a distinction between "climate changes attributable to human activities altering the atmospheric composition", and "climate variability attributable to natural causes".

Several theories have been postulated to explain the causes of climate change. From the literature, these theories can be grouped into two schools of thought. One school of thought argues that climate change can be related or attributed directly or indirectly to human activities (UNFCCC, 2007). The second school of thought also attributes climate change to natural causes. Some of these theories worthy of mention are the Anthropogenic Global Warming, Human Forcing besides Green House Gases, Bio-thermostat, Cloud Formation and Albedo, Ocean Currents, Planetary Motion and Solar Variability (Bast, 2013).

It is argued that climate change is caused by both physical processes and directly or indirectly by human factors. Earth,,s climate changes naturally. Changes in the intensity of sunlight reaching the earth causes cycles of warming and cooling that have been a regular feature of the Earth,,s climatic history. Other natural causes of climate change include variations in ocean currents (which can alter the distribution of heat and precipitation) and large eruptions of volcanoes (which can sporadically increase the concentration of atmospheric particles, blocking out more sunlight).

The crucial component that causes greenhouse gases such as Carbon dioxide, Methane, Chlorofluorocarbons (CFC,,s), and Nitrous Oxide to be released into the atmosphere is human activity. The burning of fossil fuels (i.e., non-renewable resources such as oil, coal, and natural gas) has a significant effect on the warming of the atmosphere. The heavy use of power plants, cars, airplanes, buildings, and other man-made structures release carbon dioxide into the atmosphere and contribute to

global warming. Nylon and nitric acid production, the use of fertilizers in agriculture, and the burning of organic matter also release the greenhouse gas Nitrous Oxide. These are processes that have been expanded since the mid-twentieth century (Nicole, 2012).

Climate change is a key priority for international development as its impact is likely to be disproportionately felt in developing countries. Climate change will affect all countries, but people in the poorest countries and poor people in richer countries are more likely to suffer the most. They tend to live in high- risk areas such as unstable slopes and flood plains, and often cannot afford well-built houses. Many of them depend on climate-sensitive sectors, such as agriculture, and have little or no means to cope with climate change, for example owing to low savings, no property insurance and poor access to public services. Climate change is expected to reduce already low incomes and increase illness and death rates in many developing countries. Africa, small island states, and the Asian and African mega-deltas are likely to be particularly affected by climate change (Stern, 2007).

Furthermore, increased instances of drought, flooding and severe weather events as well as incremental environmental change through processes such as inundation, desertification and salination are likely to exacerbate existing problems related to agricultural production, communicable diseases, migration streams, poverty and conflict (Bangay & Blum, 2010; Smith & Vivekananda, 2007; UNICEF UK, 2008; WHO, 2008).

An effective response to climate change and its associated biophysical and socio-economic impacts will therefore need to be multifaceted and inherently political. Thus, the concept of climate change has attracted global concern and the schools have

been charged with transmission of knowledge and skills needed by students to prevent climate change (Meng, 2009). Several countries have made strenuous efforts to include issues on climate change as part of their curriculum. This is because schools serve as places that assist students in developing understanding of society, resources, climate and climate change and also to show commitment to reducing or preventing climate change

One can attest that climate change will remain a stumbling block towards Ghana‟s quest for development as already discussed that a large portion of the country‟s budget goes to food security and health hence the other sectors of the economy are neglected. Therefore, it is imperative for teachers to understand the causes, dynamics and impacts of climate change in order to adopt a holistic approach in developing oriented and transformative capacities (Aderogba & Ogunnow, 2010). An effective national response to climate change will require informed decision making based on reliable, understandable, and timely climate-related information tailored to user needs. For example, state and local authorities need improved information and tools to plan to both reduce emissions and adapt to the impacts of climate change, and a better understanding of how the public views climate change.

It can be asserted that at both primary and secondary school level, climate change education has the potential to play a crucial role in developing awareness and improving understanding of this important issue. This in turn could drive important environmental value, attitude and behaviour changes, which may contribute to mitigating climate change (UNEP, 2006; UNESCO, 2009; Selim, 2011). According to Dlamini (2011) “education may help individuals to constitute cognizant decisions, which will benefit the environment, and thus minimise the climate change”. Actual

education is important in the sense that it has the ability to raise awareness of any issue declared a disaster, and thus inspire behavioural value and attitude changes among various members of society (UNEP, 2006).

Many countries in the world mandated their educational institutions to include climate change in their curricula. China has provided compulsory education on climate change for the world,,s population from pre-school level to the tertiary levels of education. The Chinese government has assumed climate change action plans which include specific education initiatives. Knowledge about climate change will be included in basic, higher and adult education with a focus on awareness and participation in relevant activities (Yi & Wu, 2009).

Global climate changes are complex and challenge to communicate to society, an understanding of science is fundamental to appreciating the forces the produce climate and the effect of climate change on different region of the world. in an attempt to make climate change concept a curricular issue, challenges are bound to occur, due to society unpreparedness to responds to climate change because the climate related decision and policies that need to be a citizenry that is well informed, more participatory and more engaged than it is today (NRC 2010a). In the past society has successfully copied with and adapted to the current existing relatively stable climate variability the problem now is to respond effectively to the treats presented by climate change (NRC, 2010b).

The situation makes it difficult for citizenry to become informed an educated about climate science, because science education is not readily available to everyone and scientist and educators, the insufficient capability to translate sciences to lay citizens. As a consequence, societies lack the knowledge and skills to modify its behaviour to

adapt to the effects, or mitigate climate change. Knowledge about climate change may aid to a more engaged citizenry (Kahlor & Rosenthal, 2009). Cultural diversity of our audience when tailoring message aimed at generating a sense of urgency and being a cue to act (Kahan, et al., 2011).

In the words of Furman, et al. (2009), the politicisation of the debate on climate change has led members of the public to perceive it more as a matter of personal opinion or a political ideology, distracting attention from the known facts about climate change and basic causes of those changes. In the words of Hamilton (2008), public opinion about climate change is largely influenced by political preferences. As a result, there is a serious and demonstrable need to better educate and inform decision-makers and citizens in general on the most basic facts of climate change (Hassol, 2008), to enable them generate a more climate science educated society.

Educators at all levels will also need support and training to deliver quality education about complex, climate related topics which are both relevant to local environment, social and political contexts and which meet wider educational targets e.g. literacy, numeracy employability (UNESCO, 2012). The packed curricula frequently present a challenge in mainstreaming climate change issues into the subject social studies curriculum.

There is the need for cooperation between local and international actors, to identify the most appropriate issues and areas of knowledge. The role of education in addressing the challenges of climate change is being increasingly recognised the capacity of education to contribute to adaptation and mitigation measures are yet to penetrate mainstream development thinking. The integration of climate knowledge

and skills into existing education systems represent both immediate and longer-term challenges for responding to climate change (UNESCO, 2012).

Currently, climate change education is still appurtenant topic in both education research and practice. In research literature, climate change education has been addresses almost exclusively as a domain of science education. Climate change is situated within environmental education and education for sustainable development, a minor theme with a peripheral area of the curriculum.

Geography and integrated science have been included in the Senior High School curriculum in Ghana for the purposes of teaching students to address changes in society including climate change (Ghana Education Service, 1987), social studies with its integrated and incorporative nature, that has been acknowledge as a major vehicle in promoting effective knowledge about climate change among Ghanaians students (Evans, 2009). Social studies education provides students with diverse knowledge about the social and natural environment by developing the knowledge and understanding of students on the society and the use of natural resources.

In the words of Hamilton (as cited in Baker, 2015), public opinion about climate change is largely influenced by political preferences. Sometimes, it appears that political orientation is a stronger determinant of attitudes towards climate change than other demographic attributes. The politicisation of the debate on climate change has led members of the public to perceive it more as a matter of personal opinion or a political ideology, distracting attention from the known facts about climate change and the basic causes of those changes (Furman, et al., 2009). Consequently, there is an acute and demonstrable need to better educate and inform decision-makers and

citizens in general on the most basic facts of climate change (Hassol, 2008), so as to develop a more climate science literate society.

In Ghana there is limited expertise and scientific knowledge on climate change and its impact in many developing countries are also a key concern for educators and policy makers at both secondary and tertiary levels. The level of incorporation of climate change issues will vary greatly depending on the level of education, and the local and national contexts being addressed. In primary education, for instance, a core concern is when to introduce the issue of climate change. This decision is important in order not to frighten children and young people, but to empower them to understand and critically engage with environmental change. In secondary education, tensions exist between a centralised curriculum and the need to promote locally based and locally appropriate knowledge on climate change.

Therefore, the relationship between the teacher and students is very important as the teacher‟s role model can easily influence their views. It is noted that the capacity within the secondary schools‟ system to provide robust climate change education for learners during the earlier stage of their education is limited (Bardsley & Bardsley, 2007). This may exacerbate at tertiary level. Study has shown that in secondary education, many teachers feel unprepared to teach climate change (Johnson, 2008). They may probably lose sight of the prevailing information and continue to depend on the obsolete text books. Umenduji (2012) stressed the need for experts to research and to break more grounds into the relevant knowledge in the needs, trends and patterns of changes in the weather. In order to ensure actual preparedness to teach climate change in schools, it is necessary to know the level of understanding of those that will handle the instruction. The paper therefore looks at the secondary school teachers‟ and

students perceived challenges and response to climate change in the Bolgatanga. This is informed by the fact that education plays a vital role in helping to give correct information about changes in phenomena so as to correct the misconception of students at secondary school level misconceptions generated by media coverage of the subject, leading to poorly prepared learners.

1.2 Statement of the Problem

Social Studies is a study of the problems of society. The subject prepares the individual to fit into society by equipping him/her with knowledge about the culture and ways of life of their society, its problems, its values and its hopes for the future. As a subject, Social Studies helps pupils to understand their society better; helps them to investigate how their society functions and hence assists them to develop that critical and at the same time developmental kind of mind that transforms societies" (CRDD, 2007). Social studies education at the Senior High School level has been acknowledged as one of the subjects that is in tune with the environmental issues including climate change. In this regard, it is expected that such a curriculum that is poised in dealing with environmental challenges will highlight more topics on climate change. However, it appears the curriculum efforts is not enough in addressing climate change in the social studies curriculum at the senior high school level. Athman and Monroe (2004) support this view when they state that interdisciplinary efforts to combat climate change have not been too successful in the formal education sector (Athman & Monroe, 2004. Bangay and Blum (2010), argue that "formal education is as important as health" and that an educated population is better equipped to recognize in advance the threats posed by a changing climate and act accordingly. Study has shown that in secondary education, many teachers feel unprepared to teach climate change (Johnson, 2008).

Umenduji (2012) stressed the need for experts to research and to break more grounds into the relevant knowledge in the needs, trends and patterns of changes in the weather. There is insufficient scientific knowledge and expertise in the area of climate change and its effects in developing countries pose a great problem for educator and policy makers at the second cycle level of education.

It is not clear how the existing social studies curricula addresses core issues related to climate change. The views of social studies teachers are particularly relevant for this research in the sense that in curriculum implementation, the teacher are the foot soldiers in terms of the content and learning experiences that learners are made to go through in the process of learning. Ghana‟s hope for successful climate change initiatives hinges on social studies teachers and students understanding of curriculum framework that is grounded on the values and the principles of education for sustainable development to structure a curriculum to combat climate change. There seems to be gaps in studies regarding senior high school social studies teachers and students‟ perceived challenges and response to climate change. Ghana has not given emphasis to how people‟s understandings are translated to responses. As succinctly pointed out by Mosothware (1991) teachers can provide a vital link in the delivery of environmental knowledge, its associated problems and solution. It is in this regard that the research into assesses Senior High school social studies teachers‟ and students perceived challenges and response to climate change in Bolgatanga Municipality, since education has a serious role to play in helping to give out the correct message about climate change so as to mitigate and alleviate its effects. Hence, the choice of the topic to fill these gaps.

1.3 Purpose of the Study

The purpose is to solicit teachers ,,and students views on social studies curriculum and climate change thes. It sought to examine teachers and students‟‟ level of understanding and awareness of climate change, to examine what are the ways in which climate change is addressed in the Senior High School curriculum and to examine what teachers and students perceive as challenges in responding to climate change.

1.4 Objectives of the Study

The overall objective of the research is to assess social studies curriculum and climate change: views of teachers and students in the Bolgatanga municipality

The specific objectives of the study sought to;

1. examine how Social Studies teachers and students perceived climate change
2. explore means in which Social Studies curriculum responds to climate change
3. examine what Social Studies teachers and students perceive as challenges in responding to climate change

1.5 Research Questions

The following research questions will guide the direction of the study:

1. How do Social Studies teachers perceive climate change?
2. What are the ways in which climate change is addressed in the senior high school Social Studies curriculum?
3. What do Social Studies teachers and students perceive as challenges in responding to climate change?

1.6 Delimitation of the Study

The primary focus of the study was to investigate Social Studies curriculum and climate change: Views of teachers‟ and students‟ in senior high schools. The study was confined to the Senior High Schools in the Bolgatanga municipal of Ghana. Therefore, a delimitation of the study is the restriction of the research to just Senior High School social studies teachers and students of five senior high schools in the Bolgatanga Municipality.

1.7 Definition of Terms

Anthropogenic- Refers chiefly to environmental pollution and pollutants originating in human activity.

Climate change: Refers to a change of climate that is attributed directly or indirectly to human activities and natural variation.

Global warming: Is the increase in the earth‟s surface temperature due to natural and human activities.

Greenhouse gas emissions: Is any gaseous compound in the atmosphere that is capable of absorbing infra radiation, thereby trapping and holding heat in the atmosphere.

Ice Age: Is considered a period of several hundred to several thousand years in which there are layers of ice that extend from the polar regions toward lower latitudes of above sea level to several tens and hundreds meters.

Kyoto Protocol: Is an international agreement linked to the United Nations framework convention on climate change.

Natural disaster: Refers to involvement the interaction of natural hazards, but they may have different vulnerabilities to the damages that ensure from hazard.

Sceptics: Persons who doubt the existence of anthropogenic climate change

1.8 Organisation of the of Study

The study was organised into five chapters. Chapter One contains the introduction of the research, which includes the background, statement of the problem, purpose of the study, the objectives, research questions, significance of the study, delimitation, limitation and organization of the study. Chapter Two reviews related literature under headings clearly marked based on the research objectives. Chapter Three describes the methodology used in the study. It highlighted the research design, population, sample and sampling procedures, research instrument, data collection procedures, validity and reliability of instruments and how the data was analysed. Chapter Four deal with results of the data analysis, presentation of findings and their discussion. Finally, Chapter Five provides a summary of the major findings of the study, the conclusions, and recommendations based on the findings as well as areas for further studies.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

The purpose of chapter two is to review literature related to the topic under study as documented by scholars, educationists, authorities and researchers. Since climate change has attained global prominence, it stands to reason that there will be a multiplicity of perceptions surrounding it from various sources and disciplines. The literature review is grouped into three broad sections: the conceptual review, the theoretical review and the empirical review.

The conceptual review includes the following sub-topics;

Thematic Perspectives

1. The concept of climate
2. The concept of curriculum
3. Social studies teachers‟ and students‟ perceptions understanding of climate change
4. Social Studies teachers‟ and students‟ perceptions of causes of climate change
5. Curriculum response to climate change in the SHS curriculum
6. Challenges associated with responding to climate change and the curriculum

2.1 Theoretical Framework

The main theoretical underpinning of this research is the anthropogenic global warming theory and the natural causes of climate change theory. The natural cause‟s theory will serve as a complementary theory to the anthropogenic theory in order to help the researcher go through a thorough assessment of the research problem. The integration of the two theories and its application to climate change research has been highly recommended by Al Gore (2006).

The theories and their relevance to the objectives of the research are discussed below

Anthropogenic Global Warming theory

It is a rational attempt to find answers to certain social questions pertaining to how the scientific community influences the transformation or stagnation of societal judgments; the theory enable individuals orient and master themselves in their material and social world" and to enable effective communication to take place among them. People"s perception and experiences in this case is represented by the "mind" whiles the "world" connotes scientific information.

Relevance of anthropogenic Global warming theory natural causes theory

The benefits of anthropogenic theory to researchers, policy makers, communicators and society are very enormous. It is particularly very important for both research and information dissemination in society. The theory offers a better approach for studying how the media and citizens conceptualize societal issue Aside the research benefits, AGW also helps to compare and give meaning to people"s actions or inactions and to objectify those actions as part of the general social sett-up in a changing society. Climate change is an example of such issues (Höijer, 2010). Aside the research benefits, AGW also helps to compare and give meaning to people"s actions or inactions and to objectify those actions as part of the general scientific sett-up.

AGW helps to explain how climate issue are interpreted and accepted or rejected in society. It has been used exclusively in environmental concerns (Castro, 2006) and its application in the studies of climate change in particular is proving very potent Olausson (2010) and Jaspal et al (2014).

Application of anthropogenic global warming and natural causes theory to climate change

Climate change is generally an obscure, invisible and abstract object that makes it difficult for people to fully understand (O‟Neill & Hulme 2009). As a result, most studies of climate change especially in the social sciences, are concerned with how the issue is represented in society and people‟s reactions towards it (Jaspal et al 2014). This concern is fundamentally addressed by the anthropogenic global warming theory.

The theory deals with how information circulates in society (e.g. in the media, in school textbooks and literature) and in the minds of people. Jaspal et al (2014) opines that AGW provides a framework for exploring how scientific issues such as climate change transits and diffuses into society, become connected and meaningful to people. It also helps to assess sources of societal information and communication mechanisms (Olausson, 2011; Smith & Joffe, 2013). Thus, AGW offers a very decent framework for the assessment of peoples‟ understanding of an obscure, scientifically based environmental phenomenon like climate change, how these understanding are constructed and the extent at which communication can influence these cognitive constructs in society.

2.1.1 Theories on human-induced causes of climate change

2.1.1.1 Anthropogenic Global Warming (AGW) Theory

The hypothesis of climate change that majority of people are familiar with is referred to anthropogenic (man-made) global warming (AGW). Proponents for this theory Intergovernmental Panel on Climate Change (IPCC), Al Gore and other bodies confirms that man-made greenhouse gases, primarily carbon dioxide, are the principal

cause of the global warming that happened during the past 50 years. This theory of climate change contends that human emissions of greenhouse gases, principally carbon dioxide, methane, and nitrous oxide, are responsible for a catastrophic rise in global temperatures. The medium whereby this occurs is called the enhanced greenhouse effect.

They affirm that energy from the sun moves through space and contacts earth. Earth„s atmosphere is generally crystalline to the incoming sunlight, granting it to reach the planet‟s surface where some of it is absorbed and some is reflected back as heat out into the atmosphere. Particular gases in the atmosphere, called "greenhouse gases", assimilate the outgoing reflected or internal thermal radiation, resulting in Earth„s atmosphere assuming warmer than it otherwise might be. Water vapour is the crucial greenhouse gas, accompany by carbon dioxide, methane and ozone. Throughout the past century, human activities such as burning wood and fossil fuels and cutting down or burning forests are thought to have increased the concentration of carbon dioxide in the atmosphere (Al Gore, 2006).

Earth„s climate also acknowledges that other types of extrinsic conditions, such as variation in solar radiation and in the planet „s orbit, but these "forcing", according to the proponents of AGW, cannot explain the rise in Earth „s temperature over the past three decades. The forcing created directly by man-made greenhouse gases is also small, but the AGW theory posits that positive feedbacks increase the effects of these gases between two- and four-fold. A small increase in temperature causes more evaporation, which places more water vapour in the atmosphere, which motivate more warming. Global warming may also lead to less ice and snow cover, which would lead to more exposed ground and open water, which on average are less cogitative

than snow and ice and thus absorb more solar radiation, which would cause more warming. Warming also might activate the discharge of methane from frozen peat bogs and carbon dioxide from the oceans.

Proponents of the AGW theory (Al Gore, NOAA and IPCC) believe man-made carbon dioxide is responsible for floods, droughts, severe weather, crop failures, species extinctions, spread of diseases, ocean coral bleaching, famines, and other disasters. All these disasters will become more frequent and more severe as temperatures continue to rise, they say. Nothing less than large and rapid reductions in human emissions will save the planet from these catastrophic events (Bast, 2013).

2.1.1.2 Human Forcing besides Green House Gases

The second doctrine of climate change which ascribe to the initial school of thought is Human Forcing besides Green House Gases. Roger Pielke, a leading proponent of this theory, maintain the opinion that mankind „s maximum impact on climate is not its greenhouse gas emissions, but its transformation of Earth „s surface by removing forests, irrigating deserts, and building cities. He observes that although the congenital purpose of climate variations and changes are absolutely important, the human causation are consequential and entail a assorted rank of first-order climate forcing‟s, including, but not confined to, the human input of carbon dioxide. Short descriptions of some of these "human forcing‟s" other than greenhouse gases are as follows; cities incline to be warmer than suburbs, and suburbs warmer than rural areas, as they have larger concentrations of energy-producing machines and vehicles and large amounts of concrete, asphalt, and other building and road materials that absorb solar energy and then re-emit thermal energy. Advocates of the AGW theory erroneously assign

higher temperatures caused by urban heat islands to rising atmospheric carbon dioxide levels.

Anthropogenic aerosols and ozone experience brief life span than greenhouse gases, and as a result their concentrations are higher in source regions and downwind. Pielke and colleagues evaluate the harm of human aerosols on the gradient of radiative heating on regional scales it is higher to that of the well-mixed greenhouse gases. With many surface-based temperature stations located in urban or near-urban areas, it is likely they are registering the warming effects of these aerosols and ozone, not carbon dioxide.

Clearing trees by burning, a coarse custom in developing countries releases carbon dioxide into the atmosphere and prevents forests from insulate carbon in the future. The pasture or crop land that replaces the forest lacks the shade created by a forest canopy and tends to be warmer. The IPCC has estimated that between one-quarter and one-third of anthropogenic carbon dioxide emissions are due to deforestation, not the burning of fossil fuels, though this estimate has been challenged as being too high (IPCC, 2007).

Human activities in coastal areas such as logging, agriculture, construction, mining, drilling, dredging, and tourism which are anthropogenic activities all can increase or (more rarely) decrease surface temperatures of nearby bodies of water. For example, storm runoff from city streets following heavy rains can result in seawater dilution and temperature increases. Development can produce sediment that reduces stream flow and damages coral reefs by reducing the penetration of sunlight or by direct deposit on the coral, causing damage mistakenly attributed to global warming. Anyone living in or near a large city knows that jets often leave trails behind them,

called contrails. Composed of water vapour, they precipitate the creation of low clouds that have a net warming effect).

Regrettably, as Pielke concludes, the IPCC in 2007 did not sufficiently acknowledge the importance of these other human climate forcing‟s in altering regional and global climate and their effects on predictability at the regional scale. It also placed too much emphasis on average global forcing from a limited set of human climates forcing‟s (Pielke, 2009).

2.1.2 Theories on natural causes of climate change

The second school of thought, confirm causes of climate change to natural occurrence. Several of the theories further elucidate their assertions are Bio-thermostat, Cloud Formation and Albedo, Ocean Currents, Planetary Motion and Solar Variability. Paramount defenders of these theories are Idso and Singer (2009), Gray (2009); Lindzen, et al. (2001); Sciare, et al, (2000). Above mention philosophies appeared as a backlash to the continuous dominance of the Anthropogenic Global Warming theory in almost all climate change debates. The scholars of these doctrines seek to enumerate and open other gates to the debate on climate change.

(i) Bio - Thermostat Theory

The second theory of climate change holds that negative feedbacks from biological and chemical processes entirely or almost entirely offset whatever positive feedbacks might be caused by rising CO2. These processes act as a “global bio-thermostat” keeping temperatures in equilibrium. The scientific literature contains evidence of at least eight such feedbacks as Carbon Sequestration, Carbonyl Sulphide, Diffuse Light, Iodocompounds, Dimethyl Sulphide, and other Aerosols (Idso & Singer, 2009).

Increased carbon sequestration by plants is perhaps the best-known consequence of the rise in atmospheric CO2. The productivity of most plants is enhanced because CO2 is the primary raw material utilized by plants to construct their tissues. The more CO2 there is in the air, the better plants grow and the more CO2 they remove from the air and store in their leaves, branches, trunks, and roots, as well as in the soil beneath the plants – a suite of processes called "sequestration." Higher temperatures also tend to increase carbon sequestration rates. Sequestration offsets some of the temperature-increasing power of higher levels of CO2. How powerful is this negative feedback? The answer depends on the size, growth rate, and duration of the "sinks" in which carbon is stored. These variables in turn depend on constraints to plant growth (such as lack of water or nutrients in soil), the rate at which plant material decomposes, and even how higher CO2 levels affect earthworms.

Carbonyl sulphide (COS) is a biologically produced sulphur gas emitted from soils. COS eventually makes its way into the stratosphere where it is transformed into sulphate aerosol particles, which reflect solar radiation back into space, producing a cooling effect on Earth‟s climate. The rate at which COS is emitted increases as vegetation responds to the on-going rise in the air‟s CO2 content, meaning it is another negative feedback. The latest research indicates that the COS-induced cooling mechanism also operates at sea, as higher CO2 and temperatures increase surface-water chlorophyll concentrations.

A third negative feedback phenomenon is diffuse light. As higher levels of CO2 promote greater plant productivity, plants emit greater amounts of gases converted into aerosols called "biosols." Biosols in turn act as cloud condensation nuclei, helping to create new clouds that reflect more incoming solar radiation back to space,

thereby cooling the planet. More than that, they diffuse solar radiation close to the ground, reducing shade under plant canopies and thereby enhancing photosynthesis, which increases the amount of CO2 plants absorb from the air and can sequester (Idso & Singer, 2009). How significant is this negative feedback? A 2004 study published in Geophysical Research Letters found diffuse light increased "net CO2 assimilation" by a broadleaf deciduous forest by between 30 percent and 50 percent. Once again, these effects are not adequately included in any computer model of Earth"s climate system.

Iodinated compounds, or Iodocompounds, are particles formed in sea air from iodine-containing vapours emitted by marine algae. These compounds, like the biosols previously discussed, help create clouds, which reduce the amount of solar radiation reaching the surface. Also, like bio-sols, the creation of Iodocompounds is stimulated by rising CO2 levels and warmer temperatures.

The amount of biologic dimethyl sulphide (DMS) emitted by the world"s oceans is closely related to sea surface temperature: the higher the sea surface temperature, the greater the sea-to-air flux of DMS. DMS is a major source of cloud condensation nuclei, which generate clouds with greater cloud albedo. The greater the cloud albedo, the more incoming solar radiation gets blocked and reflected out to space. How strong is this negative feedback? A study published in the Journal of Geophysical Research in 2000 found that a sea surface temperature increase of only 1°C was sufficient to increase the atmospheric DMS concentration by 50 percent. The warming typically predicted to accompany a doubling of the air"s CO2 content would increase the atmosphere"s DMS concentration by a factor of three or more, providing what the study"s authors call a "very important" negative feedback that could potentially offset

the original impetus for warming. The effects of this process are not incorporated into today‟s state-of-the-art climate models.

There are many other kinds of aerosols, which scientists classify as marine biological, terrestrial biological, anthropogenic non-biological, and natural nonbiological. Many of them are created, distributed, or destroyed in biological and chemical processes that tend to be counter-cyclical to the forcing of carbon dioxide. When carbon dioxide is plentiful or when temperatures rise, these aerosols tend to increase in presence and reflect more solar radiation away from the planet‟s surface, causing it to cool. Many studies suggest the cumulative negative forcing of aerosols is large enough to completely offset the positive forcing due to rising atmospheric carbon dioxide. Some of these individual negative feedbacks may be sufficiently large to counter much of the effect of higher levels of carbon dioxide on global temperatures. They constitute a bio - thermostat keeping Earth‟s temperature relatively stable. This would mean rising carbon dioxide would not cause catastrophic global warming.

(ii) Cloud Formation and Albedo

Another theory of climate change postulates that changes in the formation and albedo of clouds create negative feedbacks that cancel out all or nearly all of the warming effect of higher levels of carbon dioxide. This theory is based largely on observational data reported by a series of researchers, rather than computer models as in the case of the AGW theory In Yogesh, (1999). Sud (1999) a NASA scientist, and his colleagues found that changes in cloud coverage in the tropics acted as a natural thermostat to keep Sea Surface Temperature (SST) between approximately 28°C and 30°C. Their analysis suggested that as SSTs rise, air at the base of the clouds is charged with the moist static energy needed for clouds to reach the upper

troposphere, at which point the cloud cover reduces the amount of solar radiation received at the surface of the sea and cool and dry downdrafts promote ocean surface cooling. This "thermostat-like control," as Sud et al. described it, tends "to ventilate the tropical ocean efficiently and help contain the SST between 28°- 30°C." The phenomenon also would be expected to prevent SSTs from rising any higher in response to enhanced CO2 -induced radiative forcing.

(iii) The Ocean Currents Theory

The third theory of climate change contends that global temperature variations over the past century-and-a-half, and particularly the past 30 years, were due to the slow-down of the ocean‟s Thermohaline Circulation (THC). William "Bill" Gray (2009) professor emeritus of atmospheric science at Colorado State University and head of the Tropical Meteorology Project at the university‟s Department of Atmospheric Sciences, is the leading proponent of this theory. The following summary is based on several of his papers and presentations.

Ocean water is constantly transferred from the surface mixed layer to the interior ocean through a process called ventilation. The ocean fully ventilates itself every 1,000 to 2,000 years through a polar region (Atlantic and Antarctic) deep ocean subsidence of cold-saline water and a compensating upwelling of warmer less saline water in the tropics. This deep ocean circulation, called the Meridional Overturning Circulation (MOC), has two parts, the primary Atlantic Thermohaline Circulation (THC) and the secondary Surrounding Antarctica Subsidence (SAS). A slowdown of the global THC circulation occurs due to Atlantic Ocean salinity decreases. This brings about a few decades of reduction in Antarctic deep-water formation. Gray (2009) admits that changes of the Meridional Overturning Circulation (MOC) since

1995 led to the cessation of global warming since the 1998-2001 period and triggered the beginning of a weak global cooling trend since 2001. Gray projects this weak cooling to continue for the next couple of decades.

(iv) The Planetary Motion Theory

The Planetary Motion theory of climate change contends that most or all of the warming of the latter part of the twentieth century can be explained by natural gravitational and magnetic oscillations of the solar system induced by the planet‟s movement through space. These oscillations modulate solar variations and/or other extra-terrestrial influences of Earth, which then drive climate change (Bast, 2013). Earth„s orbit around the sun takes the form of an ellipse, not a circle, with the planet passing farther away from the sun at one end of the orbit than at the other end. The closest approach of the planet to the sun is called "perihelion" and the farthest is called "aphelion". Perihelion now occurs in January, making northern hemisphere winters slightly milder. The change in timing of perihelion is known as the precession of the equinoxes, and it occurs every 22,000 years.

Earth also spins around an axis that tilts lower and then higher during a 41,000-year cycle. More "tilt" roughly means warmer northern hemisphere summers and colder winters; less "tilt" means cooler summers and milder winters. The coincidence of these cycles is known to lead, with the help of positive climatic feedbacks such as water vapour, to the cooling and warming periods we recognise from historical data.

Variations in the earth„s movement around the sun changes climate in two main ways: the varying tidal gravitational and magnetic forces of the planets on the sun, in particular of Jupiter and Saturn, modulate solar activity and then solar variations modulate the terrestrial climate and secondly, the varying gravitational and magnetic

fields generated by the movement of Jupiter and Saturn modulate some terrestrial orbital parameters, for example the spinning of Earth better known as the "length of the day" (LOD), which then drives the ocean oscillations and, consequently, the climate (Scafetta, 2009). Scafetta tested this theory using the sun‟s movement relative to the centre of mass of the solar system (called the "barycenter") as a proxy for all the known and unknown cycles involving natural oscillations of the solar system. He found "all alternating periods of warming and cooling since 1860 are very well reconstructed by the model." He goes on to use the model to predict future climate change.

(v) Solar Variability Theory

The fifth theory of climate change in view of the second school thought advance that solar variability accounts for most or all of the warming in the late twentieth century and will dominate climate in the twenty-first century regardless of man-made greenhouse gas emissions. Active mixing of gases on the near surface of the Sun, denoted by changes in the number of sunspots, causes changes in the radiant energy emitted by the sun in cycles of roughly 11 and 210 years. There is evidence that Earth‟s climate warms and cools in synchrony with these cycles.

Solar flares, which are bursts of energetic particles and radiation from the surface of the Sun, can work additively. These events cause an outflowing of charged particles - called "solar wind" - that reaches Earth and its atmosphere. Solar wind affects galactic cosmic rays, which in turn affect cloud formation. Changes in cloud formation are linked to variations in sea surface temperatures, wind patterns, and the oceans Thermohaline circulation. This factor is especially important during periods of solar

activity minima because of the least resistance to incoming cosmic rays imposed by the solar wind (Bast, 2013).

The theoretical review considered seven theories from two school of thought which have been review under the theoretical related literature. These include;

1. The Anthropogenic Global Warning Theory and the human Forcing besides Green House Gases Theory as propounded by scholars who accept that climate change is human-caused.
2. Bio-thermostat, Cloud Formation and Albedo, Ocean Currents, Planetary Motion and Solar Variability Philosophy as proposed by those who consider climate change to be naturally-caused.

The empirical literature covered studies conducted by scholars, educationists and researchers including Buadi (2012); Wolf and Moser (2011); Alice & Abdulraheem (2012); Adebayo, Mudasiru and Saheed (2012); Baker (2015), Anderson and Wallin (2010).

2.2 The Concept of Curriculum

The concept of curriculum has no single accepted definition, which is widely use Curriculum from the Latin word means “the path, the way, and the course”, (Collins English Dictionary, 2003); and according to Rugg in Adeyinka (1988), the curriculum is really the entire programme of the schools' work. Curriculum says, “Of all that the students could learn, this is what they must learn, and of all the things we could teach, this is what we must teach”. The amorphous nature of the word curriculum has given rise over the years to many interpretations. Depending on their philosophical beliefs, people have expressed their interpretation to be among the following: Curriculum is Content, Curriculum is a programme of study or a course of study, is everything that

goes on within the school, including extra-class activities guidance and interpersonal relationships, is a series of experiences undergone by learners in school and is that which an individual learner experiences as a result of schooling.

As defined in this fashion, curriculum is simply the list of skills that we wish our students to learn (Null, 2011). In a broad sense McKernan (2013) says, "A curriculum is more like a musician's folio than an engineer's blue print". Carl (2009) said that curriculum is therefore a broad concept which may include all planned activities and thus also subject courses which take place during a normal school day. It also includes after school planned activities, such as societies and sports.

This all takes place within a specific system, is continuously subject to evaluation and the aims lead to accompany the child to adulthood so that he/she can be a useful citizen with in community. (Schubert, 1986 as cited in Anderson, 2004) tries to makes different images or characterization of understanding of the curriculum. Curriculum as Subject Matter is the most traditional understanding of curriculum as the combination of subject matter to form a body of content to be taught.

Curriculum is the planned and unplanned activities that learners go through in a school environment that help to develop the mental faculties of learners, transform the behaviour and attitude of learners to contribute to societal development. It is the curriculum that provides the needed guidance in schools for educational aims, goals and objectives to be achieved. Education is the key ingredient for change by which learners come to terms with the social, physical and economic environment that has a direct impact on their source of livelihood. This presupposes that the curriculum must be tailored to satisfy the needs, aspirations, curiosity, frustrations and survival of the learner. Bondi and Wiles (1998), point out that there will never be a perfect

curriculum for all ages. Since society and the environment keeps changing and the changes create new needs and challenges, the curriculum can never remain static. It has to grow to address new societal needs and demands dictated by current issues of mutual concern.

2.3 The Concept of Climate

The concept of climate is associate to incessant investigation of the weather elements. Climate as the average weather for a particular region and time period, usually taken over 30-years. It's really an average pattern of weather for a particular region. When scientists talk about climate, they're looking at averages of precipitation, temperature, humidity, sunshine, wind velocity, phenomena such as fog, frost, and hail storms, and other measures of the weather that occur over a long period in a particular place (NASA, 2005).

Weather, state of the atmosphere at a particular place during a short period of time. It involves such atmospheric phenomena as temperature, humidity, precipitation (type and amount), air pressure, wind, and cloud cover (NASA, 2005). The Intergovernmental Panel on Climate Change (IPCC) defines climate change as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and or the variability of its properties and the changes persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.

The difference between climate and weather is usefully summarized by the popular phrase "Climate is what you expect, weather is what you get". Climate is different from weather, in that, weather only explains the short-term conditions of these variables in a given region. A region,,s climate is generated by the climate system,

which has five components: atmosphere, hydrosphere, cryosphere, land surface, and biosphere. The climate of a place is affected by its latitude, terrain, and altitude, as well as nearby water bodies and their currents

2.4 The Understanding of Climate Change

Understanding is a clear goal of many educational initiatives focused on climate change. How people understand climate change and the reasons for these understanding have been the focus of increasingly prolific research. Climate change is one of the major challenges in the world and adds considerable stress to societies and to the environment. From shifting weather patterns that threaten food production, to rising sea levels that increase the risk of catastrophic flooding, the impacts of climate change are global in scope and unprecedented in scale. Without drastic action today, adapting to these impacts in the future will be more difficult and expensive (UNEP, 2009). This has prompted scientists, researchers, educationists, policy makers and governments to give this global phenomenon the desired attention.

Evans and Steven (2007) admit that the first World Climate Conference was held in 1979, and the Second in 1990. The Intergovernmental Panel on Climate Change (IPCC) was set up in 1988 and its first report was produced two years later. In recognition of the negative impact of climate change is the institution of the Kyoto Protocol (1997) which is an environmental treaty to the United Nations Framework Convention on Climate Change (UNFCCC). Its aim is to fight global warming.

Climate is defined as the long term mean and variability of temperature, precipitation, and wind over a number of decades (usually 30 years) for a geographic location (Glickman, et al., 2000). Often climate is interpreted as the statistical collection of weather experienced at a location over a long period of time (Trewartha & Horn,

1954). Inter-governmental Panel on Climate Change (IPCC) defines climate change as any significant change in climate over time whether due to natural variability or as a result of human activity (IPCC, 2007e). This change is scientifically assessed through the common climatic measures of temperature, precipitation, or wind, over an extended period, usually decades or longer. Often, the phrase „climate change" and „global warming" are used interchangeably but National Academy of Sciences recommends using „climate change" as it implies changes in addition to the rising temperatures (NAS, 2008).

Climate change in IPCC usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC) which attributes climate change directly or indirectly to human activities. The IPCC„s definition recognises both human activities and natural phenomena as the driving forces behind climate change.

Climate change has been defined by Weber (2010) as systematic changes in average conditions over time. These changes are difficult to observe and discern without statistical measurement, and this makes it difficult for the sceptics to believe climate change is happening (Weber 2010). Although climate change may occur in different parts of the world, it will result in heterogeneous effects which may result in the destruction of some ecosystems (Brody et al., 2008; Leiserowitz, 2005). Climate change is not a new phenomenon, as early as 1827 Fouries noted an increase in

atmospheric carbon dioxide (CO2) levels and greenhouse gas effects (Leiserowitz, 2007). There have been many workers in this field until, notably, Calendars made a link between climate change and anthropogenic climate change in the 1930s (Hulme 2009). Yet there are different schools of thought on what causes climate change, the most dominant being anthropogenic and natural causes. When the link between climate change and emissions was made, the fossil fuel industry in the United States of America in the late 1980s launched a public campaign to discredit science and the anthropogenic causes of climate change (Lorenzoni et al., 2007). This campaign and other causes have made it more difficult to convince some members of the public about the link between climate change and human behaviour.

Quite a number but similar definitions have been given to explain climate change by diverse institutions and individuals. The United States of America‟s NOAA (2007) defines climate change as a long-term shift in the statistics of the weather (including its averages). Within the purview of the IPCC (2014), climate change refers to a change in the state of the climate that can be identified by long term changes (usually a decade or more) in the mean and/or the variability of its properties. The UNFCCC (2014) gives a similar definition but in addition, attributes climate change as either directly or indirectly to human activity. A simple analysis of the various definitions explains climate change as change in climatic conditions within a longer time frame as a result of human activities and or natural variations.

Numerous occurrences have been used to represent the manifestations of climate change. The IPCC (2013) mentions events such as rising atmospheric temperature and atmospheric water vapour, changes in rainfall patterns, melting of glaciers, ocean and land ice, and general rise in sea levels as some occurrences of climate change. These

changes have also been observed by a number of scientific researchers but they however, divert at the point where the causes of the problem are discussed.

The changes can be caused by natural processes like volcanic eruptions, variations in the sun „s intensity, or very slow changes in ocean circulation or land surfaces which occur on time scales of decades, centuries or longer. But humans also cause climates to change by releasing greenhouse gases and aerosols into the atmosphere, by changing land surfaces, and by depleting the stratospheric ozone layer. Both natural and human factors that can cause climate change are called „climate forcing"s „, since they push, or „force" the climate to shift to new values (Climate Change Fact Sheet, 2013). It must be emphasised, however, that the concept „climate change" is different from „global warming" but sometimes people use the two concepts to mean the same thing. It is important at this stage to clarify this public misunderstanding for the purpose of this work.

Climate change refers to general shifts in climate, including temperature, precipitation, winds and other factors. Global warming (as well as global cooling) refers specifically to any change in the global average surface temperature. Global warming is often misunderstood to imply that the world will warm uniformly. In fact, an increase in average global temperature will also cause the circulation of the atmosphere to change, resulting in some areas of the world warming more, others less (Climate Change Fact Sheet, 2013).

Global Warming also describes the average temperature of the Earth„s oceans, land and atmosphere. The individual measurements are from a very large, international network of weather observations, and typically averaged on a yearly basis. It also

relates to the general increase in the earth‟s near-surface air and ocean temperatures (IPCC, 2007).

2.5 Perceptions of the Causes of Climate Change

Psychologists have been researching and theorizing on how people and societies perceive and respond to natural and human-made risks for a long period (Hacking, 2003). Slovic (1987) notes that sometimes public perception of such risks contrasted sharply with objective risk assessments made by experts.

2.5.1 Teachers and students' perceptions of climate change

Climate change perceptions are generally defined as people‟s awareness about causes of climate change and its adverse impacts (Leiserowitz, 2006; Whitmarsh, 2008a). It is important to note that perception is narrowly defined here with an explicit importance on awareness or familiarity of the issue. However, this research project has extended the concept of perception to the level of knowledge, which reflects individuals‟ awareness of facts, concepts and relationships concerning causes, consequences and solutions to climate change. This definition of perception indicates a conscious understanding of climate change and associated risks, not a mere „awareness‟ or „familiarity‟ of the topic.

Teachers understanding has also been regarded as an important factor in influencing policy decisions of climate change issues (Leiserowitz, 2006). Capstick and colleagues (2015) provided a thorough review of empirical literature on public perception of climate change published between 1980 and 2014. With a reference to public opinion surveys conducted across the world between 2009 and 2018, they argued that despite some divergences in public opinion at times, the relative importance of climate change was consistent in the public‟s minds. Jasanoff‟s (2010)

study, Lorenzoni & Pidgeon, 2006; Leiserowitz & Smith, 2010). These studies found that lay people demonstrated an awareness about climate change issues without being able to identify its causes and impacts. For example, Leiserowitz and Smith‟s (2010) study in the United States found that despite being aware of climate change most respondents failed to explain reasons of global warming.

The perception of the reality and the causes of climate change as a risk domain are closely related concepts (Hanson-Easey et al. 2013). Hanson-Easey and Augoustinos (2010) affirm this by positing that knowledge about causes is not sufficient in making sense of phenomena but, in their judgment, can serve to justify and or excuse social action. Reser, et al. (2012) argue that climate change is framed in public and scientific discourses in terms of the causal role of human activities. This line of discourse, in the view of Bostrom et al. (2012), is very potent because they are highly capable of influencing individuals‟ acceptance of various climate change and adaptation issues. Notwithstanding, the convergent of literature and theories on public understanding and perception of climate change has been noted to be very diverse. Due to this diversity, Reser and Swim (2011), for instance, attempt to synthesize countless psychological, environmental, and social factors mediating human responses to climate change.

The earth „s climate has varied considerably in the past, as demonstrate by the geological substantiate of ice era and sea level changes, and by the archives of human history over many hundreds of years. The causes of past changes are not always clear but are generally known to be related to changes in ocean currents, solar activity, volcanic eruptions and other natural factors (UNISDR, 2009). The difference now is that global temperatures have risen remarkably rapidly over the last few decades.

There is strong manifest of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising average global sea levels. The IPCC Fourth Assessment Report concludes that the global warming is unequivocal. It additional posits that increasing concentration of greenhouse gases is accountable for most of the observed temperature increase since the middle of the 20th century. Atmosphere and ocean temperatures are higher than they have been at any other time during at least the past five centuries, and probably for more than a millennium (UNISDR, 2009).

The conviction that human action are the causes of climate change has become part of the climate change „panic" in which individuals and groups have been arouse into frenzied moments of ecological modernism and green radicalism (Isaksen 2013). This line of reasoning is of the opinion that any successful mitigation measure must include the reduction of our "carbon footprint".

The fact that climate change is anthropogenic appears to have been confirmed by many researchers, scientists and international bodies (Oreskes 2004; Leiserowitz 2005, 2006, 2007; IPCC, 2007; Cook 2010; Murray 2011). According to Cook (2010), countless climate scientists who have actively published climate research reported that 97% of climate professionals are convinced that human activities are changing global temperatures. Cook also looked at all peer-reviewed research on the subject of global climate change published between 1993 and 2017 and found out that among the 928 papers, not a single paper rejected the consensus position that human activities are causing global warming.

Climate scientists argue that the beginning of industrialization was the beginning of climate change (Weber et al. 2011; Martinez, 2003; Hamilton 2010). These groups of scientists have argued that the energy behind industrialisation (coal, natural gas, oil) and the products of industrialisation (aerosols, fertilisers, pesticides, plastics, and cans) have been the main forces behind erratic climatic conditions. The IPCC (2013) has also weighed in by contending that natural and anthropogenic substances and processes that alter the earth‟s energy budget are drivers of climate change

the most important component that causes greenhouse gases comparable as carbon dioxide, Methane, Chlorofluorocarbons (CFC „s), and Nitrous Oxide to be discharged into the atmosphere is human activity. The burning of fossil fuels (i.e., non-renewable resources such as oil, coal, and natural gas) has a considerable effect on the warming of the atmosphere. The arduous use of power plants, cars, airplanes, buildings, and other man-made architectures discharged carbon dioxide into the atmosphere and bestow to global warming (Nicole, 2012). Substantial aggregate of these emissions emanate from the industrialised nations are reaching disquieting proportions. The quest for industrialisation and urbanisation is the trigger causes of the greater demand for energy and its attendant effect.

As such this school of thought argues that most of the observed increase in global average temperatures since the mid-20th Century is very likely due to the observed increase in anthropogenic greenhouse gas (GHG) concentrations (IPCC 2013, p.39). According to the IPCC report (2013) greenhouse gas (GHG) emissions due to human activities have grown significantly since pre-industrial times, with an increase of 70% between 1970 and 2017. The glaring amounts of pollution from industries and exhaust fumes are too obnoxious to ignore. These industries and their processes are human-

made is not without controversy. As such, the conclusion that the earth is warming up as a result of human activities, primarily due to rising levels of carbon dioxide and other heat-trapping atmospheric gases created by burning fossil fuels, can seem plausible (Maibach et al., 2011). That is why this position (Anthropogenic Global Warming) has gathered a lot of support among scientists, with only 0.7% rejecting it between 1991-2011 (Cook et al 2013). Gases that contribute to the greenhouse effect include: Water vapour, the most abundant greenhouse gas, acts as a feedback to the climate. Water vapour increases as the Earth „s atmosphere warms, but so does the possibility of clouds and precipitation, making these some of the most important feedback mechanisms to the greenhouse effect (NASA, 2015).

Depletion of the ozone element available at the stratosphere is another significant cause of climate change. Chlorofluorocarbons and halons are principally accountable for this depletion. The above mention two gases are extremely sluggish chemical compounds which are crushed down almost entirely by photodecomposition in the stratosphere, hence, their ozone depletion on global warming potentials. This gives an imprint that the more these CFC „s are released into the atmosphere, the higher the rate at which global warming would occur since it will act as a catalyst in speeding up global warming leading to climate change.

In Ghana, there is an exceptional growth in the number of human activities that trigger climate change includes burning of fossil fuel, especially petroleum products in vehicles, generators and other industrial machines. Obeng (2012), stated that there is an increase in second hand vehicles which are imported in towns and cities. Besides, the inefficient hydro-electrical power supply system in the country has resulted in the increasing use of generators. Increase in the number and use of

vehicles and generators, coupled with poor servicing record of owners, result in the production of a lot of smoke which increases the carbon dioxide concentrations. Secondly, the promiscuously bush burning for hunting and farming purposes also sum up to the production of greenhouse gases for the cause that deforestation increases the carbon dioxide concentrations since plants and trees which make use of it are destroyed (Obeng, 2012).

In Ghana the menace of illegal mining activities leads to the pollution of water bodies and land in almost every part of the country, sometimes to the extinction of water bodies. This affects the rainfall cycle. The effects of indiscriminate dumping of refuse that degrades the land and water bodies. The imported old refrigerators and air conditioners which contain an aggregate of chlorofluorocarbons (CFC‟s) as coolant, the appliance when not accurately disposed away when they are no longer in use and the gases leak out into the environment (Forster, et al., 2007).

It can be deduced from the arguments above that, uninterrupted warming of the earth by increase discharge of greenhouse gases such as carbon dioxide, methane, nitrous oxide and CFC „s as well as depletion of the ozone layer in the atmosphere directly or indirectly by human inventiveness and by physical factors are the main causes of climate change. The diagram below gives a brief causes and effects of climate change.

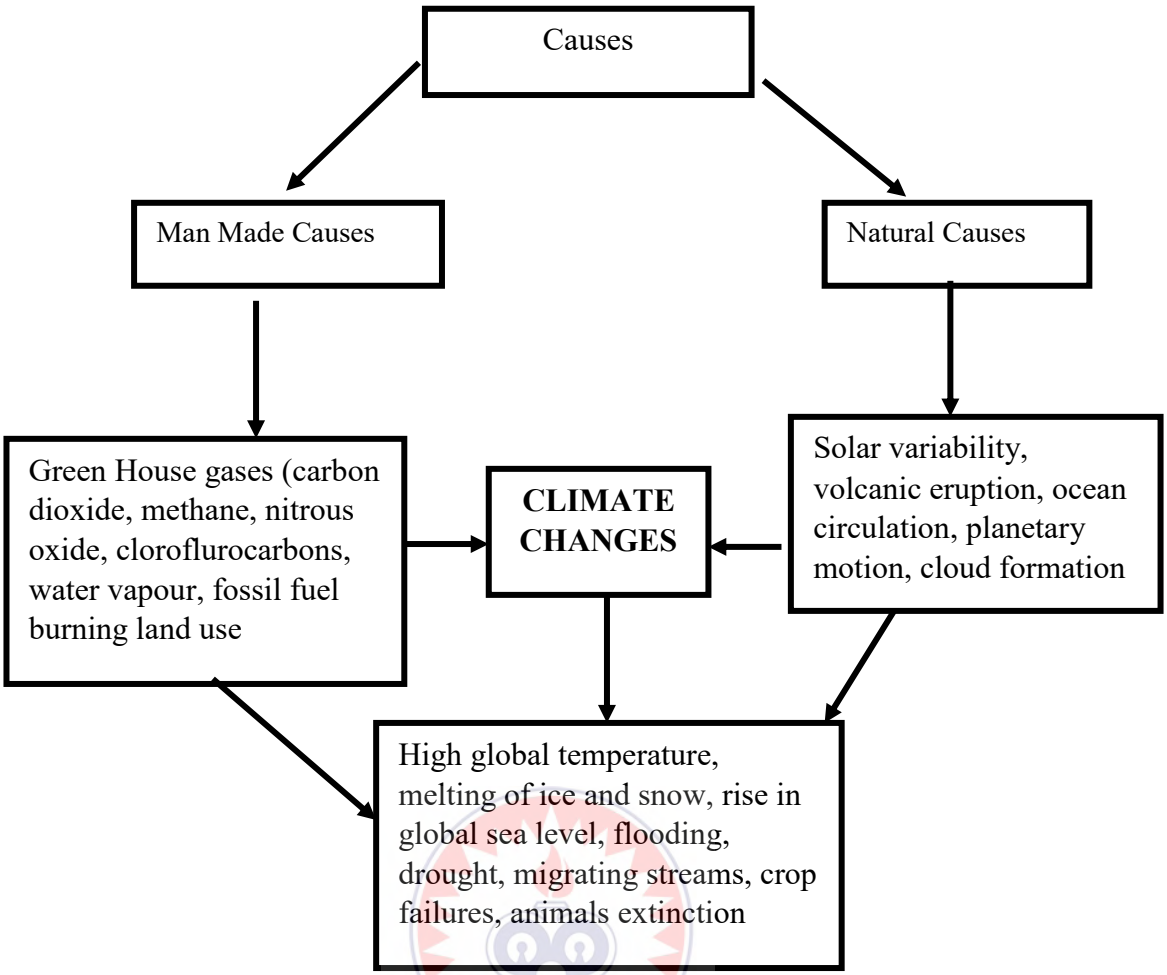

Figure 2.1: Causes and Effects of Climate Change

Source: Author construct (2021).

From Figure 1 above, it can be ascertained that the causes of climate change emerge from two sources (Man-made and Natural). The human induced causes of climate change are the emission of greenhouse gases such as carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and water vapour as well as fossil fuel burning, land use among others. The natural causes, on the other hand, are propelled by factors such as solar variability, volcanic eruption, ocean circulation planetary motion, cloud formation and albedo etc. These two sources together drive climate change and subsequently, lead to high global temperatures, melting of ice and snow, rise in global sea level, flooding, drought, migrating streams, crop failures, and animal extinction water bodies.

2.6 Curriculum Response to Climate Change

The fragile nature of the earth today as a result of a changing climate is a danger to humanity as well as to our natural environment and thus requires urgent attention. Nkechi (2014) argues that education is a most powerful weapon for such needed change and direction. The arguments are supported by Ukeje (2000) who argues that education is so powerful that it can heal and build but the same depends on the type of education provided and particularly the teacher who is the pillar of the education process. Similarly, UNESCO (2009), argued that education has a central role to play in understanding, mitigating and adapting to the changing climate. They added that although education at all levels and in both formal and informal settings is needed, imparting climate change understanding and awareness at a young age is the best way to change attitudes and behaviours.

Across the world the term curriculum is used in several different ways. According to Pratt (1994), and Barrow and Milburn (1990), the word "curriculum" is derived from the Latin verb currere, "to run." "Currere" became a diminutive noun and meant a "racing chariot" or "race track." Later an extension was made that associated the term with curriculum vitae that means "the course of one"s life." It was also associated with curricula mentis that figuratively refers to "the (educational) course of the mind." After the nineteenth century the term became commonly used in the educational field. Over the years several writers have advanced different definitions for the concept of curriculum. For instance, Saylor and Alexander (1954), defined it as the total effort of the school to bring about desired outcomes in school and other teaching institutions. Hirst (1968) observes that the term curriculum is of course excessively broad, I shall take it to mean a programme of activities designed so that pupils will attain as far as possible, certain educational ends or objectives. A curriculum usually contains a

statement of aims and specific objectives. It indicates some selection and organisation of content; it either implies or manifests certain patterns of learning and teaching. Finally, it includes a programme off evaluation of the outcomes (Taba, 1962).

Robinson (1983) states that the curriculum can be defined as a course of learning activities set out for the learner to perform to make him achieve certain goals prescribed by the educational system. The curriculum generally includes all subjects and activities over which the school has responsibility. It also defines the limits within which certain types of learning are to take place. It denotes those experiences and activities which are devised by the school or other institutions of learning for the purpose of changing a learner‟s behaviour, acquiring or reinforcing certain skills and preparing him to fit properly into his society.

Similarly, Offorma (2002), referred to curriculum as the total experience involving the school in the process of educating young people which includes the subjects, content, teacher, method of teaching and evaluation as well as the psychological and physical dimensions of the experience. Again, Miller and Seller (1985) as cited in Baker (2015) aver that curriculum is an explicitly and implicitly intentional set of interactions designed to facilitate learning and development and to impose meaning on experience. The explicit intentions usually are expressed in written curricula and in courses of study; the implicit intentions are found in the „hidden curriculum‟ by which we mean the roles and norms that underlie interactions in the school. From the definitions above, it can be inferred that the term curriculum has different meanings and interpretations based on the orientations of the various experts in the field and how each of them sees it. Curriculum goes hand in hand with the concept of a syllabus.

According to Kelly (2009), curriculum differs from syllabus in different ways, such as: whereas curriculum refers to a blue print of education at a certain level, a syllabus refers to the quantity of content to be taught in an academic year/term. Again, curriculum is long term in nature and visionary while a syllabus refers to content to be covered in a particular time. Lastly, curriculum is a macro plan constituting a whole while on the other hand a syllabus is a micro plan which is a part.

Perspective in the context of social studies instruction about the climate change in senior high school have particular fallacies associated with depletion. As a result of the growing recognition that climate change is under way and poses serious risks for both human societies and natural systems, the question that decision makers are asking has expanded from "What is happening?" to "What is happening and what can we do about it?". Scientific research can help answer both of these important questions. In addition to the extensive body of research on the causes and consequences of climate change, there is a growing body of knowledge about technologies and policies that can be used to limit the magnitude of future climate change, a smaller but expanding understanding of the steps that can be taken to adapt to climate change, and a growing recognition that climate change will need to be considered in actions and decisions across a wide range of sectors and interests (Bahar, et al., 2018).

Any educational activity and process to be successful depends on content or subject matter to be imparted by the teacher to the learners. Content is the most important aspect in the teaching and learning process. Gosse and Hansel (2014) emphasize the importance of content in the curriculum when they compare it to oxygen in human beings. Teachers come to class to deliver content which develops knowledge planned

in the lesson. Learners pick the content from class and make reflections, develop innovations and find ways of applying in their daily lives, Content is all that schools have and offer.

Gosse and Hansel (2014) urge that teaching is always about something, and that something has to be specified before any decision can be made. The "something" is in reality the content. The content is a necessary condition for improving schools, closing the achievement gap, engaging parents and preparing teachers. Therefore, when educators take the content for granted, they lose the opportunities to coordinate and collaborate the learning experiences (Gosse & Hansel, 2014).

Teachers play an important role in choosing content to create awareness and foster interest in children by planning the environment and introducing new and stimulating objects, people and experience. While content is critical for achieving the desired objectives of various curricula, many curricula globally have inadequate content to realize the intentions of instruction (Stern & Stern, 2011). This limits the achievements of goals and objectives of teaching and learning.

2.6.1 Climate change content in the curriculum

A number of studies have investigated the formal education system and found out that climate change content does not appear in the curricula of various countries i.e. Ghana, Kenya, Seychelles, Nepal, Swaziland (Ndiritu et al, 2016; Ocheing & Koske, 2013; Bajracharya, 2012; Dlamini & Shongwe, 2015). In some countries environmental themes that provide an opportunity to teach and learn about climate change exist but climate change per se is not explicit (Chineka & Chabikwa, 2015; Alberto, 2015, Taba et al., 2015). For example, in Ghana and other Africa countries like Tanzania, climate change content has always appeared in the school curriculum at

primary and secondary school level although it is not explicitly stated (Hanai & Ndibuni, 2015). However, the existence of climate change content in the curriculum is not a magic bullet because there are other challenges that can hinder its teaching. For example, in South Africa and other Africa countries, climate change is included in the curriculum but many teachers have no capacity to teach it (Togo et al., 2015).

Climate change is included in curriculum of Zambia as a separate topic but does not provide any definition of the concept and the curriculum only outlines globalized causes, effects, mitigation measures and the impact of climate change in a very simplest way. The lack of an impact of Secondary School Geography and social studies contextualized content in climate change coverage would do more harm to the learners because they wouldn"t appreciate the essence of learning about it (UNESCO, 2012; Muchanga & Nakazwe, 2015). Content is found in learning resources i.e. the syllabus, text books, video, CD rom, photographs, etc. These learning resources i.e. syllabus, textbooks are trusted by teachers as authoritative and objective sources of information (UNESCO, 2016). But in many parts of Africa, textbooks are either not available or not adequate and worse still outdated (UNESCO, 2016; Kira & Komba, 2015). Some social studies text books have unclear concepts regarding the issues climate change and other textbooks refute scientific findings on climate change (Kira & Komba, 2015; UNESCO, 2016).

In South Africa, climate change related resources which are tailor made to suit the curriculum are available and produced in series i.e. learner"s textbooks, learner"s workbooks and copyright free materials, however teachers lack skills and expertise to use the materials (Togo et al., 2015). These limit the possibility of the education system addressing climate change effectively to learners.

Conceptualization of Curriculum and its developmental process, implementation and evaluation are as varied from one philosopher to another; from one educator and/or educationist to another and from one generation to another in time and space. However, there is the common understanding that curriculum is a set of planned and organized material designed for an intended learning outcome, considered as adequate for any functional expectations of a people in time and space. There is no doubt that this definition appears simplistic and less inclusive of the many factors that continually present challenges to developers and operators of a given curriculum package. The curriculum makers need to base their work upon the National Policy on Education, Ghana‟s Vision 2025 on education and human capital development, and the global trends so that learners will have opportunities for better educational programmes.

There is the whole world of differences between the planned and intended curriculum by a state or a nation for each subject area and for the various levels of educational ladder, for example, in Ghana, The Ministry of Education through its special agencies like GES, NACCA., etc., have always prepared general curriculum materials for almost all the conceivable subject areas for the primary, secondary and some selected tertiary education programmes. However, besides this level of curriculum conceptualization and development process, there is the Implemented Curriculum, which is exactly what is being organized and taught at different levels and evaluated by evaluation and certification syndicates or consortia. From all reasonable considerations, it is only when these various conceptualization perspectives are met that the entire education industry would have achieved the objectives embedded in the respective curriculum processes and packages (Okobiah, 2009).

In contemporary age, colleges and universities are being called upon to provide all students with high-quality, effective educational experiences, which groom these students to live and work in a highly different society. In response, various educational and training approaches are being used to help students develop specific behaviours, attitudes, and skills to enable them to work effectively in cross-cultural situations. This implies that students must be trained in a holistic manner such that the varied dimensions of challenges of aggressive society at the moment can be reduced with an amalgamated approach. This also means that issues of climate change which is a global challenge cannot be left out in the curriculum of schools at the moment.

Educating people from early stages of learning about climate change and its impacts is rationale in promoting responsible behaviour. The curriculum provides an educational framework which outlines the content, teaching strategies and learning experiences with expected outcomes and behavioural objectives (Lunenburg, 2011). In essence, the curriculum is an important tool in behavioural transformation and delivering climate change message to students who constitute the majority of the world population. However, the current curriculum does not adequately address the issue of climate change. Hence there is need for reforms so as to improve the status quo and mainstream climate change education in the curriculum.

Chakeredza et al. (2009) highlighted that education prepares an individual to become a functional member of the society. Incorporating and mainstreaming climate change in the education curriculum enable students to have a thorough understanding of the issue so as to effectively and efficiently participate in the promulgation and formulation of climate change policies. This also reduces resistance to and criticism on climate change.

All over the world, governments are implementing initiatives concerning climate change. China has 9 years of compulsory education, which operates in 90 per cent of populated areas. China introduced environmental education in the late 1970‟s as a result of increased attention to sustainable development and the need to protect the environment. Following the United Nations Conference on Environment and Development (Rio de Janeiro, 1992), environmental education moved towards environment, population and development, and finally education for sustainable development. The Chinese government, for example, has adopted climate change action plans which include specific education initiatives. Knowledge about climate change has been included in basic, higher and adult education with a focus on awareness and participation in relevant activities (Yi & Wu, 2009).

Education is identified as a key contributor to the behavioural changes required achieving sustainable development objectives. While a top-down approach has been favoured in dealing with sustainable development and climate change issues. The first principle to address climate change is to address it within the framework of sustainable development. Climate change arises out of development, and should thus be solved along with development. It is necessary to promote sustainable development amidst efforts to address climate change, and strive to achieve the goal of win-win in both.

The UN Climate Summit (COP15) held in Denmark in December 2009 provided the impetus to develop a number of national ESD policy initiatives A new national school curriculum adopted in 2009 included elements of ESD and CCE. The concept of sustainability was embedded in the goals describing the interrelationships between nature and society. CCE is mostly approached as teaching climate science, but it was

also included in subjects such as geography and social studies, where the interrelationships between human behaviour, consumption and climate are examined

In a similar effort to combat climate change the Danish government‟s 2009 Education for Sustainable Development (ESD) strategy also launched a number of specific initiatives concerning Climate Change Education. New Climate Change Education initiatives under the rubric of Environmental Education and Education for Sustainable Development can likewise be found in other countries (Breiting, et al., 2009). The Danish government affirms that "education for sustainable development should be pursued at all levels of education.

Canada‟s provides a framework and vision to enhance Canada‟s education system and educational outcomes through quality lifelong learning for all. ESD has been identified as one of the key priority areas, aimed at raising students‟ awareness and encouraging them to become actively engaged in working for a sustainable society. The plan affirms the importance of education in addressing climate change. The action plan document realises that the importance of education in addressing climate change cannot be stated enough. Accordingly, on-going curriculum development and renewal have been taking place in all school curricula at the province of Newfoundland and Labrador.

In addition to these government-led initiatives, there are also examples of other concrete initiatives organised by Non-Governmental Organisations (NGO‟s) and other institutions. Furthermore, in Brazil, various other stakeholders like the corporate sector, academic community and media are also involved in debating the role and place of climate change education (Jacobi, et al., 2009).

This climate change education and the efforts various countries have made towards incorporating it into the curriculum of schools is supported by the United Nations Framework Convention on Climate Change (UNFCCC) Article 6: Education, Training and Public Awareness, which recognises that education, must play a key role in a holistic response to climate change at local, national and global levels. United Nations Education, Scientific and Cultural Organisation, for example, promotes the continuous strengthening of the interdisciplinary climate change knowledge base, primarily involving the sound and unbiased generation and use of data, information and research concerning climate change (climate science) assessment, monitoring and early warning of relevance to climate change mitigation and adaptation (UNFCCC, 2007).

This UNESCO Policy Dialogue brief provides recommendations and guidance to decision makers in terms of how education systems need to be adapted and re-oriented to best address the challenge of integrating Climate Change Education for Sustainable Development (UNESCO, 2010). Policies that do not take account of the social drivers and impacts of climate change are unlikely to succeed in protecting the interests of the most vulnerable. The strengthening of the interdisciplinary climate change knowledge base as reported by UNESCO, it is believed, will improve understanding of the social dimensions, including gender equality issues related to climate change, and develop and implement a policy-relevant, action-oriented research programme focusing in particular on the design and implementation of appropriate climate change adaptation action.

Ghana is not an island when it comes to the climate change menace in the world. Climate change is a global challenge that requires a concerted effort by all nations. The National Climate Change Policy (NCCP) is Ghana‟s integrated response to climate change. It has been prepared and designed within the context of national sustainable development priorities; it provides a clearly defined pathway for dealing with the challenges of climate change within the current socio-economic context of Ghana, and looks ahead to the opportunities and benefits of a green economy. There have been national calls to reduce human activities, especially, the burning of fossil fuels (e.g. coal and oil) which intensify climate change (Evans, 2004). The evolution of the society from a traditional low technology base to a modern high-technology society has increasing environmental impact. The recent discovery and exploration of crude oil in Ghana imposes certain demands on the environment through water pollution and gas flaring, which also pollutes the air. These, added to the pre-existing environmental problems are likely to aggravate the situation (Boadu & Oden, 2013).

Climate change has equally introduced hot weather conditions, crop failure, hunger, outbreak of strange diseases, among others. Owing to this development, Fischer, et al. (2005) indicate clearly that if caution is not taken large portion of Sub-Saharan Africa‟s land will soon become less suitable for agricultural purposes. This is in addition to death of livestock, and alarming rate of diseases such as malaria, resulting from rising temperature.

President Nana Addo Dankwa Akufo-Addo has said to stop climate change, world leaders must put aside the “unnecessary arguments” and rather channel their energies and resources into what can be done to counteract climate change and its devastating effect, especially in Africa. “It is in our own interest to fight climate change decisively

(Times News, 2019). A recent report of an inter-governmental panel on climate change concludes that the global community has only 12 years to stop climate change," he said. The President, who was speaking at an Africa (2019 Climate Chance Summit in Accra). President Akufo-Addo, who is the co-Chair of the UN Group of Eminent Advocates for the 2030 UN Sustainable Development Goals (SDGs), said climate change was not only the biggest threat to the realization of the SDGs but also having an impact on survival. He said the negative effects of climate change were already being experienced in Africa through prolonged and intense droughts in eastern Africa, unprecedented floods in west Africa, the depletion of rainforests along the Equator, increasing ocean acidity around Africa‟s southern coast and vastly altered weather conditions and patterns that were threatening agricultural productivity, food security, health, water and energy security on the continent.

In furtherance of this, the dependence on rain-fed agriculture across the country makes farmers in Ghana particularly vulnerable to climate change. For instance, the high level of dependence on agriculture for livelihoods in the northern Ghana in particular, also makes it the most vulnerable region to climate change (Obour, 2013). The area is also climatically sensitive with low, decreasing rainfall and frequent recurring droughts making the situation more serious. Mr. Emmanuel Salu, Director and Head of Environmental Education Department of the Environmental Protection Agency (EPA) said this at a workshop on Environmental and Climate Change Policy Node held in Accra. The workshop, organised for stakeholders and institutions by the Centre for Scientific and Industrial Research (CSIR) - Science, Technology, and Policy Research Institute (STEPRI) in collaboration with the Alliance for Green Revolution Africa (AGRA) was on the theme: "Enhancing the Adaptation of

Smallholder Farmers Especially Women to Climate Change for Improved Agricultural Production in Ghana" (Obour, 2013).

In response to climate change, Ghana has launched a National Climate Change Policy (2013) that would provide strategies and actions, which when effectively implemented, it is believed, would help mitigate the effects of climate change on the country. The Policy, which was recently approved by Cabinet, is in three phases with the first phase being the presentation of the policy, analysing the current situation and giving the broad policy vision and objectives. The second phase presents the initiatives and programmes identified in the form of action plans for implementation, while the last phase details how climate change programmes and actions, identified in the second phase, could be mainstreamed, time-bound, budgeted for and translated into annual work plans of implementing units (Yeboah, 2013).

According to Acting Executive Director of Environmental Protection Agency (EPA), Mr John A. Pwamang Primary school pupils, will from the forthcoming academic year -beginning September - start learning climate change and green economy as part of the new education curriculum. The study of the phenomenon that bothers on environmental degradation has been integrated into the various subjects, chiefly Science, Geography and Religious and Moral Education (RME). In English Language for instance, the pupils could be asked to write essays on climate change, its effects on the country and provide solutions to address its impacts. According to Mr, Pwamang, the move was to help imbibe environmental consciousness into pupils to help mitigate impacts of climate change. He was speaking at a workshop held on Tuesday in Accra where Teaching and Learning Materials (TLMs), designed to teach the new discipline, were reviewed by stakeholders in education and environment issues. The

workshop was attended by representatives from the National Council for Curriculum and Assessment (NaCCA) Unit of the Ghana Education Service (GES), the United Nations Institute for Training and Research and other institutions which collaborated with the EPA on the project.

He added the integration of climate change into the curriculum was a component of a National Climate Change and Green Economy Learning Strategy developed by the agency and its partners. He said the agency had since 2017 been working together with the Ghana Education Service to ensure the effective integration of climate change matters into the education curriculum. "Climate change has become an important issue. Some of the interventions require a change in our attitude and we think the best way to do this is to start from the school system." "When they get this information into their learning materials, they would be able to make the necessary changes and as we go along, we can address the impacts of climate change.

The Ministry of Environment, Science, Technology and Innovation (MESTI) in particular has sought to ensure that the development agenda of government responds to the emerging trends of global warming and to how Ghana could better contribute to the common objective, and to position herself as a leader within the Africa region. Ghana is keen to include climate resilience in its development. In addition, Ghana is adequately represented at various international conferences on climate change to keep abreast with developments in global and regional thinking and decisions on climate response measures, as have been deliberated and agreed by the parties. Since Ghana joined the global community on climate change, the Government has been making strides towards fulfilling its obligations under the climate change convention and the Kyoto Protocol (MESTI, 2013).

The government of Ghana has also shown commitment when it promised sustainable funding for climate change. It was announced that government is exploring ways of carrying out sustainable surveillance on the emergence of climate change and environmental degradation. This surveillance would also be backed by sustainable means of acquiring funding, to propel the policies by mobilising resources from all the necessary avenues to execute the agenda (Arhin, 2014). This was said at the official launching of the National Climate Change Policy and National Environment Policy in Accra, as one of the measures Ghana was taking in reaction to the global challenge of climate change and environmental degradation.

However, the policy appears to be a bit more silent on the curriculum efforts that can be made to infuse the concepts of climate change into the curriculum of schools. This in my view is the missing link between policy and implementation. This policy gap needs to be filled the essence of which this research was conducted. If the issue of climate change which has become one of the global environmental threats is to be curtailed, then the role of education cannot be overemphasised. This is because it is through education that knowledge, concepts, values and skills about climate change can be internalised by students to transform the attitude, behaviour and disposition of the learner.

Through education, students may become climate sensitive and contribute their quota in the nation‟s resolve to combat climate change. I believe Social Studies curriculum with its integrated nature offers a brighter opportunity in terms of addressing environmental issues such as climate change. This makes it imperative for curriculum experts in the field of Social Studies education to turn the attention of government and the NGO‟s to this global menace by incorporating and utilising the principles of

education for sustainable development to structure a holistic curriculum to better respond appropriately to climate change.

Some inferences can also be made from the discussions that several countries on the globe have made strenuous efforts to respond appropriately to the issues of climate change by utilising the principles of education for sustainable development and incorporating it into the existing curriculum of schools. This is evident from the report submitted by various countries on the platform of The International Alliance of Leading Education Institutes on the subject Climate Change and Sustainable Development: The Response from education.

2.7 Challenges Associated with Climate Change and the SHS Curriculum

In contemporary ages, climate change bear admitted considerable all-inclusive attention. Climate change exhibits a solitary challenge. The universe is developing quickly economically, ecologically, technologically, culturally; in conditions of population, international relations, and social structures. These adjustments emanate in elevated anxiety amidst development and sustainability. At current, accelerating climate change has drawn increased attention to this tension advice from scientists have expanded and a mood of urgency marks the present situation (UNESCO, 2012).

Conventionally, educational institutions were confirmed and organized on the basis of a strong belief in objective knowledge and forming the „right „answers to every question. In this light, the task of education was to provide students with the truth and correct techniques. This role is still valid as factual knowledge and efficient techniques are crucial prerequisites for rational action. It should not be the singular approach. Climate risks contain a degree of uncertainty and addressing them requires being able to assess the interplay between a number of aspects, including ethical

considerations of what is good and bad, rather than of solely aiming to uncover the truth (UNESCO, 2012).

National Research Council (NRC) also reports that society is not prepared to respond to climate change because the climate-related decisions and policies that need to be made over the next decades will require a citizenry that is better informed and more engaged than it is today (NRC, 2010a). History shows that society has successfully coped with and adapted to the existing relatively stable climate variability; the challenge now is to respond effectively to the threats presented by climate change (NRC, 2010b). All types of decision-makers (e.g. governments, businesses, and individuals) are already taking actions to respond to climate change (NRC, 2010c). However, large segments of society still remain unconvinced that climate change is real (Kohut, et al., 2009). Society as a whole must realise that climate change is happening and that human activity is playing a part in this change (NRC, 2011; Hassol, 2008).

The truth is that global climate changes are complex and challenging to communicate to society. An understanding of science is fundamental to appreciating the forces that produce climate change and the effect of changing climate on different regions of the world. However, science education is not available to everyone and scientists and educators, in general, lack sufficient capability to translate sciences to lay audiences. This situation makes it difficult for people to become informed or educated about climate science. As a consequence, society lacks the knowledge and skills to modify its behaviours to adapt to the effects, or mitigate, climate change. Greater awareness or knowledge about climate change may lead to a more engaged citizenry (Kahlor & Rosenthal, 2009), but only if special attention is directed to the cultural diversity of

our audiences when tailoring messages aimed at generating a sense of urgency and being a cue to act (Kahan, et al., 2011).

The sustainability of our society within an ever-changing climate, regardless of the source of change, requires that we place climate science education, including education about climate change, on a level of education similar to that of the basic sciences, such as biology, chemistry, and physics. This is consistent with National Research Council‟s recommendation in its report on Informing an Effective Response to Climate Change (2010a) that the Government should establish a national task force that includes formal and informal educators, government agencies, policymakers, business leaders, and scientists, among others, to set national goals and objectives, and to develop a co-ordinated strategy to improve climate change education and communication.

Further, challenge reputable of reference is that climate change has appeared around the past two decades as an issue of global political and social significance. The progeny was given political authenticity by key actors like Thatcher in the late 1980s, and by the collaborative involvement of both political and scientific representatives in the production of the IPCC‟s reports. The weight of scientific evidence demonstrating the reality of the threat from climate change was effectively a precondition for government commitment potentially to transform economies and human behaviour (O„Riordan & Rayner, 1991). Hamilton (2008) admits that public opinion about climate change is largely influenced by political preferences. Sometimes, it appears that political orientation is a stronger determinant of attitudes towards climate change than other demographic attributes. The politicisation of the debate on climate change has led members of the public to perceive it more as a matter of personal opinion or a

political ideology, distracting attention from the known facts about climate change and the basic causes of those changes (Furman, et al., 2009). Consequently, there is an acute and demonstrable need to better educate and inform decision-makers and citizens in general on the most basic facts of climate change (Hassol, 2008), to develop a more climate science literate society.

There will be significant challenges to integrating in education the knowledge and skills required to respond to the impacts of climate change. The level of incorporation of climate change issues will vary greatly depending on the level of education, and the local and national contexts being addressed (UNESCO, 2012). In primary education, for instance, a core concern is when to introduce the issue of climate change. This decision is important in order not to frighten children and young people, but to empower them to understand and critically engage with environmental change. In secondary education, tensions exist between a centralised curriculum and the need to promote locally based and locally appropriate knowledge (UNESCO, 2012).

Overloaded curricula frequently present additional challenges. Identification of the most appropriate issues and areas of knowledge will require cooperation between local, national and international actors. Educators at all levels will also need support and training to deliver quality education about complex, climate related topics in ways which are both relevant to local, environmental, social and political contexts, and which meet wider educational targets (e.g. literacy, numeracy, employability).

Additionally, the confirmed deficiency of scientific education and competence about climate change and its influence in many developing countries are also a key concern for educators and policy makers at both secondary and tertiary levels. At present, climate change education is still a peripheral topic in both educational research and

practice. In research literature, climate change education has been addressed almost exclusively as a domain of science education. Within the realm of practice, climate change is situated within environmental education and education for sustainable development, a minor theme within a peripheral area of the curriculum. Although the role of education in addressing the challenges of climate change is being increasingly recognised, the capacity of education to contribute to adaptation and mitigation measures has yet to penetrate mainstream development thinking. In practical terms, the integration of climate knowledge and skills into existing education systems represents both immediate and longer-term challenges for responding to climate change. The immediate task is to climate proof education systems (adaptation), while the longer-term call is to develop education systems that equip learners with the requisite skills, knowledge and attributes to deal with future challenges.

The over dependence on the scientific literature on climate change has given room for people in society to treat it as a science only issue which must be explained in the field of science education. This implies that those in the field of arts and humanities as well as lay persons in society are deprived of knowledge about climate change. I am of the view that scientific knowledge that is discovered has implications on society, because scientific knowledge and facts are discovered in order to solve problems that confront humanity. This presupposes that scientific facts and knowledge about climate change must be made available to people in society. Education is seen as one of the key areas through which this can be achieved. There is, therefore, the need to structure a holistic curriculum that will demystify the myths surrounding scientific knowledge and facts about climate change and also cater for the varying needs and aspirations of learners and stakeholders in society.

The Social Studies curriculum with its integrative nature and place in the Ghanaian educational system I believe will more likely make a huge impact in transforming the knowledge base of learners, effect attitudinal change and provide requisite skills needed to combat climate change and its devastating impacts. That was one of the reasons why the researcher undertook this research to investigate whether the integrated Social Studies curriculum in Ghana has responded appropriately towards climate change education.

From the literature, schematic framework of anthropogenic climate change drivers, impacts and responses can be described. The framework was adapted to explain the concept of climate change and its impact on both human and earth systems. In figure 2, it can be demonstrated that climate change bluffs both Earth Systems and Human Systems.

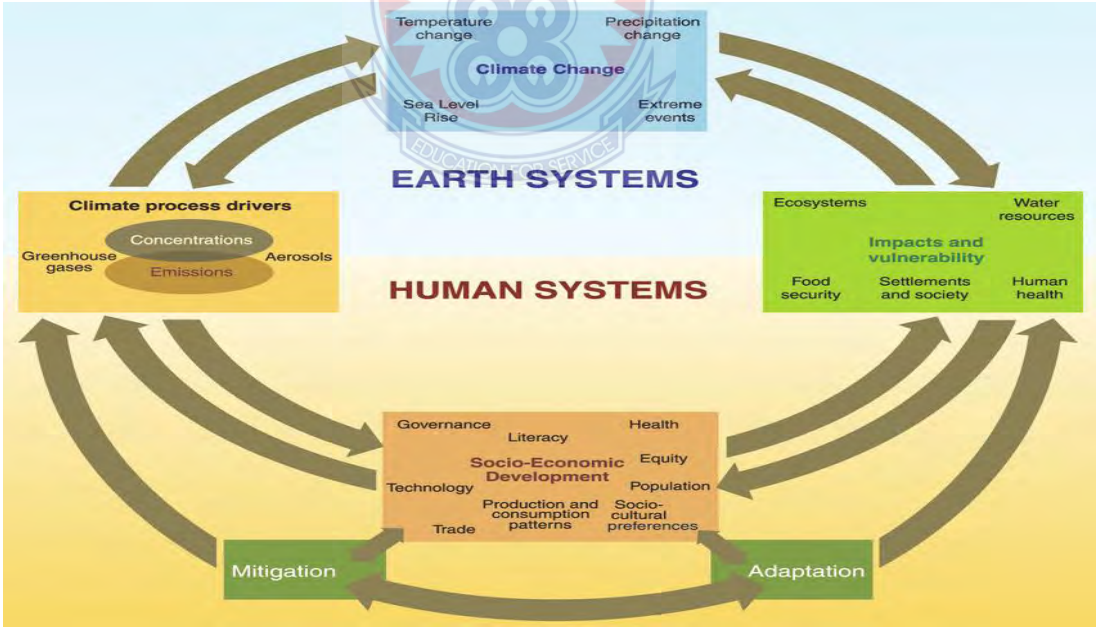

Figure 2.2: Schematic framework of anthropogenic climate change drivers, impacts and response

Source: IPCC, 2007.

These are the ecosystems, water resources, settlements and society, food security and human health. The major climate process drivers include emissions and concentrations of Greenhouse gases and aerosols. These processes lead to changes in temperature and precipitation, rise in sea level as well as extreme events such as droughts, flooding, wildfire, insects, and ocean acidification. Socio-economic development which improves the well-being of the human systems is greatly compromised. This is because climate change has an impact on governance, literacy, health, equity, technology, production and consumption patterns, trade as well as socio-cultural preferences.

This in effect implies that socio-economic development will experience a serious setback since more resources might be directed towards climate change adaptation and mitigation strategies. It is, therefore, evident from the framework that the two main ways through which these impacts can be minimised or dealt with are the adaptation and mitigation strategies. Societies can respond to climate change by adapting to its impact and by reducing greenhouse gas emissions (mitigation) thereby reducing the rate and magnitude of change (Climate Change Synthesis Report, 2007).

2.8 Models of Curriculum Evaluation

Curriculum may be said to be a total package of what schools do to make learners become what society expects them to become, namely good citizens, who are not only able to understand or learn school subjects but fully integrated individuals that are able to fit into society and contribute their own quota as well, to the progress of that society. The word evaluation is to form an idea or judgement about the worth of something. It includes, of course, making judgement so that decision might be made

about the future of programme, whether to retain the programme as it stands, modify it or throw it out altogether.

A model is a representation of a system that allows for investigation of the properties of the system and, in some cases, prediction of future outcomes. Curriculum evaluation is therefore the process of passing judgement on educational programmes. It is "a process of appraising educational programmes to determine whether or not, programme goals has been achieved" Daramola (1995). Bloom (1972) defined evaluation as "the systematic collection of evidence to determine whether in fact certain changes are taking place in the learners, as well as to determine the amount of or degree of change in individual students". Stake (1967) said that, evaluation is comprehensive, giving a full description (of performance) with statistical support, showing what happen, highlighting the merits and shortcoming of a programme and offers generalization for "the guidance of subsequent educational programme".

It is difficult to get a single correct way to conduct an evaluation in education. This has given rise to several models of curriculum evaluation in education. Some of these evaluation models worthy of mention are: objectives-based evaluation, formative and summative evaluation, decision-oriented evaluation, goal-free evaluation, responsive evaluation, and illuminative evaluation among others. The evaluation model to use depends to a large extent on the goals and objectives of what is to be evaluated. This research was based on the decision-oriented evaluation. Borich (1991) affirm that decision-oriented evaluation is a process that produces information for selecting among alternative courses of action. He states: "An evaluation is decision-oriented if it services a decision, implies a choice among alternatives, and is used in committing resources for the next interval of time before another is to be made". Stufflebeam et

al. (1971) whose work represented one of the first attempts to consider evaluation from a decision perspective, in their Context, Input, Process and Product (CIPP) model of evaluation, identify four types of evaluation for different educational decisions. This evaluation model requires the evaluation of context, input, process and product in judging a programme,,s value.

The context evaluation helps to identify needs, set objectives and plan or choose strategies for achieving the objectives; input evaluation serves structural decisions by projecting and analysing procedural designs; process evaluation which is also a programme monitoring activity to detect procedural or design defects is a record of the actual implementation process; and product evaluation identifies and assess programme attainments and also provides decisions on the continuation, modification or termination of the programme. CIPP model of evaluation is a decision-focused approach to evaluation and emphasises the systematic provision of information for programme management and operation. In this approach, information is seen as most valuable when it helps programme managers to make better decisions, so evaluation activities should be planned to coordinate with the decision needs of programme staff. In this regard, data collection and reporting are then undertaken in order to promote more effective programme management. Since programmes change as they are implemented, decision makers need could change so the evaluation activities have to adapt to meet these changing needs as well as ensuring continuity of focus where appropriate in order to trace development and performance over time.

The CIPP framework was developed as a means of linking evaluation with programme decision making. It aims to provide an analytic and rational basis for programme decision-making, based on a cycle of planning, structuring, implementing

and reviewing and revising decisions, each examined through a different aspect of evaluation -context, input, process and product evaluation. Stufflebeam viewed evaluation in terms of the types of decisions it served and categorised it according to its functional role within a system of planned social change. The CIPP model is an attempt to make evaluation directly relevant to the needs of decision-makers during the different phases and activities of a programme. In the CIPP approach, in order for an evaluation to be useful, it must address those questions which key decision-makers are asking, and must address the questions in ways and language that decision-makers will easily understand.

Climate change is an on-going global phenomenon which poses a serious threat to mankind. Due to its devastating impact, it has become necessary for curriculum of schools to respond appropriately to curb this menace. The CIPP model of curriculum evaluation upon which this research was based deals with a cycle of planning, structuring, implementing and reviewing and revising decisions, each examined through a different aspect of evaluation-context, input, process and product evaluation. This implies, in evaluating the Social Studies curriculum response to climate change, one needs to look at the programme objectives and needs of society, take a critical look at the structure of institutions, as well as the implementers of the curriculum and examine the extent to which Social Studies education has responded appropriately in turning out students who are climate sensitive in character. This is because programme evaluation is a systematic collection of information about the activities, characteristics, and outcome of programmes for use by specific people to reduce uncertainties, improve effectiveness, and make decisions with regard to what those programmes are doing and affecting (Patton, 1986).

2.9 Empirical Review

Distinct research has been carried out to find out how worldwide climate has changed and how the curriculum of schools in all over the globe has reacted to this universal menace. A research was carried by Alice and Abdulraheem (2012) on "Creating Climate Change Awareness on the Nigerian Citizens: Challenges for Social Studies Curriculum Planners and Implementers". It establishes that the impact of climate change includes floods, landslides, drought and famine. For this justification, they ascertained that as weather becomes fiercer and storms increase in frequency and intensity, serious socio-economic consequences result. Malnutrition and disease become common occurrences. Despite these multi- various impacts of climate change, the biggest obstacle is the lack of its awareness and knowledge and that Nigerians need to be educated and informed about it.

The investigators proposed that to deal with climate change and its accompanying effects has to be from the premature stage in school, right from the basic to the highest level. As long as climate is not confined to any particular discipline, and the fact that Social Studies is a problem-solving subject whose contents are derived from different areas, to deal with the problems which man is cladding in his environments, its curriculum should be expanded to include essential feature of climate change. Boadu and Oden (2012) conducted a study on Climate Change and Development in Ghana: Implications for curriculum Innovation in Senior High School Social Studies and Language Arts Curricula. It was noticed that climate change is a global circumstance which has been chiefly associated to the activities of man in the biosphere. It has identically produced about dangerous consequences in the human ecosystem and accordingly requires mitigation measures if man,s survival in the environment as well as his quality of life are to be assured.

The analyst hence investigated the abstraction of climate change, its effects on humans and the environment and the various actions that have been taken globally to meet the challenge. They advanced analysed the contents of both the Social Studies and language arts curricula for SHS in Ghana to determine the extent to which they are capable of advancing knowledge and skills on climate related issues. While the Social Studies curriculum was found to reflect environment related topics to some extent, the language arts curriculum was found not to reflect any.

Situated on these conclusions, the investigators approved that climate change education be amalgamated into both curricular, using either the interdisciplinary, multidisciplinary and trans-disciplinary approach. While they championed for inclusion of more climate related topics into the Social Studies curriculum, the analyst called for the use of climate related topics in the teaching of language and literary based skills. On the repugnant, the study fell inadequate of the causes of climate change which is the root of the problem.

In addition, Okpalaeke (2012) also conducted a study on the topic "Profile of Temperature Changes and Rainfall Patterns in Ghana from 1931 to 2007". The study was to afford confirmation of climate change in Ghana by analysing available rainfall and temperature records of mean monthly minimum and maximum temperature data for Kumasi, Accra and Navrongo synoptic stations. They were analysed for 30 years periods interval, 1931-1960, 1961-1990 and 1991-2007. Comparisons were made in order to determine the differences in climate statistics between the three periods reflecting global warming.

In general, there had been consequential increase in temperatures from January to December over the stretch of study, although not all the districts showed an increasing temperature pattern. From the records, there had been an average increase of 1.1 0 C, 0.8 0 C and 1.2 0 C in maximum temperatures from 1961 – 1990 to 1991 – 2007 for Navrongo, Accra and Kumasi respectively. There was a significant reduction in annual rainfall in some months, while others had increases. Generally, there was a significant increasing trend in maximum temperatures. Temperatures rose to their absolute peak in March and April, and dropped to their lowest in August. These changing trends have had serious effects on agriculture practices and disease vector distribution. Despite the fact that the study had revealed an evidence of rising temperatures and fall in rainfall statistics in Ghana indicating climate change, it did not tackle the causes of climate change and perception of teachers and students as well as how the curriculum can respond to climate change. Added to this, it failed to put in the picture the challenges that the curriculum would face in answering to climate change.

An investigation was conducted by Adedayo, et al. (2012) in Nigeria to find out the perceptions of teachers and students on climate change and the implications for curriculum development. The explanations for the study stanch out from their opinion that climate change is one of the pressing issues of our time. Thus, if humanity is to respond to the challenges posed by climate change, education which is the process of developing individuals and the society has vital role to play.

The investigation was toted out to probe the perceptions of teachers and students of secondary schools in South Western States of Nigeria about climate change. Random sampling technique was used to select 1000 students and 500 teachers from the

region. Data were collected using questionnaire. The data 79 collected were analysed and presented using frequency counts, percentages and test statistical techniques.

The results showed that majority (84%) of the teachers were aware of climate change; while majority (69%) of the students indicated low awareness of the phenomenon. Based on the findings, it was recommended, among others, that: climate change should be introduced into the basic education curriculum while programme on climate change should be introduced into teacher education studies. However, the study did not consider the challenges that would emerge as a result of introducing topics on climate change into the curriculum. Also, the study failed to find out how the curriculum reciprocate to climate change.

Furthermore, Buadi (2012) carried out a study on the topic "Curriculum Response to Climate Change and Development." He stated that in contemporary times there have been many bizarre experiences about the climate in Ghana. These include: floods, rainstorms and an extraordinary heat in the atmosphere. Scientists venture explanations and point to the fact that the occurrences are due to climate change phenomenon. The survey examined what climate change is and the challenges it brings upon the environment and its humans. The survey observed that the development of every nation depends, to a large extent, on the climatic conditions of the place since such conditions can affect whatever things people do, it behoves every nation to study the characteristics of climate change so as to know its consequences and get ready to mitigate the negative effects.

The research document proposes that Ghana,,s primary, secondary and tertiary school curriculum can facilitate in disseminating the characteristics of climate change phenomenon. The curriculum, which is the set of courses, course work and content

proposed at a school or university in Ghana,,s educational system should include studies on climate change so as to help learners, who are the future policy makers, to understand the phenomenon of climate change and how to deal with its challenges. This will enable them to further prepare themselves to mitigate the negative consequences of climate change. Recommendations were made as to how the modification in the school curriculum can be affected in Ghana, in particular. The study can be criticised on grounds that it did not highlight the causes of climate change which is one of the fundamental ways to address climate change.

2.10 Summary of the Literature Reviewed

The literature review accentuate issuance that border on the conceptual framework which dealt with the concept curriculum, climate, Social Studies teachers understanding of climate change, Social Studies teachers and student‟s perception of the causes of climate change, the extent to which Social Studies curriculum has responded to climate change and challenges Social Studies curriculum faces in responding to climate change.

The theories that buttress the concept of climate change have been discussed. theories can be grouped into two schools of thought based on their line of argument in explaining the causes of climate change. One school of thought argues that climate change is caused by human activities. The theories which are in favour of the human-induced climate change are the Anthropogenic Global warming theory and Human Forcing besides Green House Gases theory. The second school of thought also affirms that climate change is created by natural occurrences. Few of the theories avant-garde in line with their assertions are bio-thermostat, cloud formation and albedo, ocean currents, planetary motion and solar variability.

Models of curriculum evaluation have been examined. It has been pointed out that it is difficult to get a single correct way to conduct an evaluation in education. This has given ascent to several models of curriculum evaluation in education. Some of these evaluation models worth noting are: objectives-based evaluation, countenance evaluation, formative and summative evaluation, decision-oriented evaluation, goal-free evaluation, responsive evaluation, and illuminative evaluation among others. The evaluation model to use lean to a large extent on the goals and objectives of what is to be evaluated. This research was based on decision-oriented evaluation. Decision-oriented evaluation is a process that produces information for selecting among alternative courses of action. An evaluation is decision-oriented if it services a decision, implies a choice among alternatives, and is used in committing resources for the next interval of time before another is to be made. This evaluation model requires the evaluation of context, input, process and product in judging a programme‟s value. The basic aim is to provide an analytic and rational basis for programme decision-making, based on a cycle of planning, structuring, implementing and reviewing and revising decisions, each examined through a different aspect of evaluation -context, input, process and product evaluation.

Many researches have been carried out to find out how global climate has changed and how the curriculum of schools in the world has answered to this global threat. It is evident from these studies that several nations in the world have made positive strides in incorporating and utilising the principles of Education for Sustainable Development to structure a curriculum response to combat climate change. This research sought to find out curriculum efforts that Ghana has made to curb this global menace.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The chapter discusses the research paradigm, approach, research design, population and method of sampling and the procedure for collecting primary data. The chapter also presents an overview of the study area, as well as the study design adopted for the study. Other issues contained in the chapter are the discussions of the target population, the determination of the sample size and the sampling process. Research instruments for data collection, pre-testing of the instruments; data collection procedure, data analysis tools and ethical issues pertaining to the research are all discussed in this chapter.

3.2 Study Area

The Bolgatanga Municipality is located in the Upper East Region and is bordered to the north by the Bongo District, to the south by Talensi District, east by Bolgatanga East District and to the west by the Kassena-Nankana Municipality and Kassena Nankani West District. The Bolgatanga Municipality lies between following latitude and longitude (10.7875°N, 0.8580°W), about half (50.20%) of the population in the municipality is rural. The Bolgatanga Municipal Assembly occupies a land area of 729sq km. The climate of the area is tropical with two distinct seasons, specifically wet season (May to October) and a dry season (November-April). The Municipality is divided into three (3) administrative zones known as Zonal Councils. They are Bolgatanga, Zuarungu and Sumbrungu-Sherigu Zonal Councils. The population of the Municipality was recorded as 131,550 with 52.3% being female while the male population was 47.7%. About half (50.20%) of the population in the municipality is rural (2010 Population and Housing Census). The economy of the Bolgatanga

Municipality has been categorized into three major sectors such as primary, secondary and tertiary. The primary sector of the municipality is predominantly agricultural in nature. The secondary sector comprises Small-Scale Industrial Enterprise activities while the tertiary sector engages in the provision of services. There are some deposits of gold in some parts of the Municipality. The area produces many crops like groundnuts, shea nuts, dawadawa, soya beans, handicrafts, basket weaving, and leather work. All these contribute to employment in the Municipality. The Municipality has a lot of tourist attractions like Tanzui Shrine, the Craft Village, the smock market and some festivals like Adakoya and Naba Yeska (The Municipal Assembly"s Composite Budget, 2013).

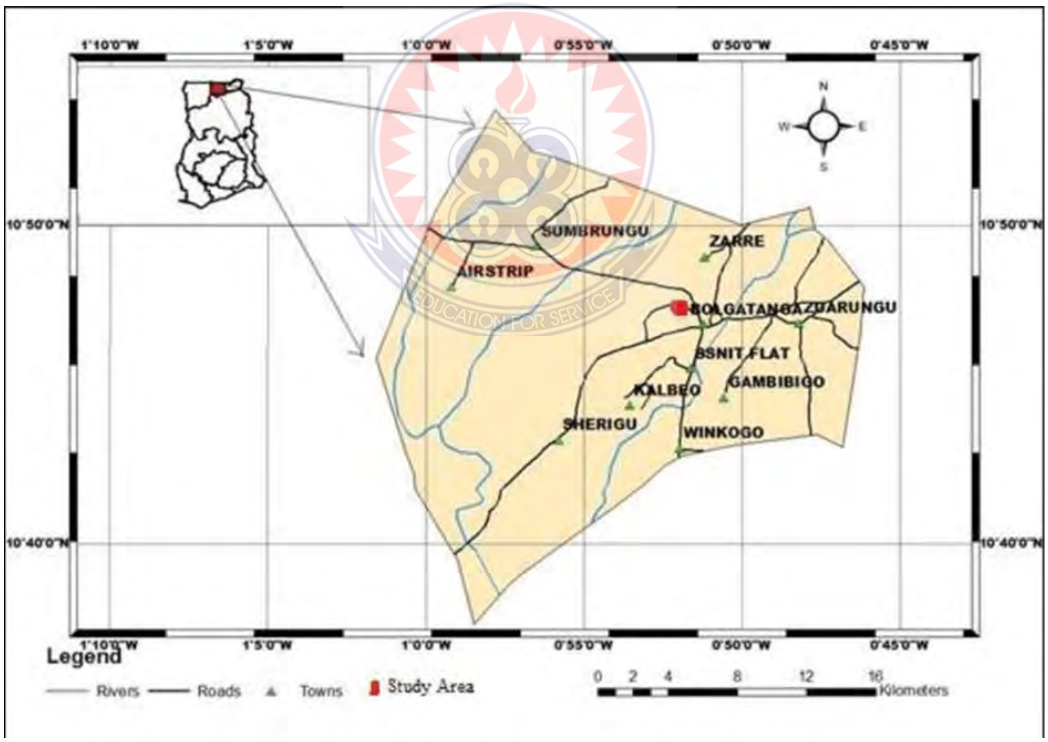

Figure 3.1: An extract of the study area map

3.3 Research Paradigm

Pragmatism is mainly pluralistic and oriented towards what works (Creswell 2014). Pragmatic has "a logic of inquiry that primarily focuses on problem solving and outcomes, allowing one to make use of a myriad of methods for the practical purpose of induction, deduction and abduction" (Greene & Hall, 2013). Multiple source of evidence are mixed to attain and modify knowledge which in turn informs potential solution to problems that will help to answer research questions as well as provide a deeper understanding of the problems (Greene & Hall, 2013). A pragmatic approach to choosing the most appropriate method for a study acknowledges that each of the chosen method has it merit and demerit and no one method is superior to the other.

This study used a mixed method design and was guided by the researcher experience. In mixed methods research, both quantitative and qualitative methods are combine (as opposed to subscribing to one method) to meaningful generate information that address research questions (Creswell, 2014). A researcher assumption (Greene & Hall 2013) past experience understanding and knowledge of a community they have worked in an can form a background on which the choice of research methods for a particular study can be made. In this case the researcher used his experience as a teacher in determine which method worked best for this study. From my experience while working as a teacher of social studies, I observed that teachers and student often had a lot say when it came to expressing their thoughts and feelings on an issue of the environment.

Therefore, using quantitative methods alone would have restricted how much they had to share on particular topics, meaning not all their views and experience would have been included in the survey. Interviews help to further explain some issues the

quantitative survey cannot elaborately, address and provide a deeper understanding of the problem

3.4 Research Approach

A mixed methods approach was chosen based on the findings of the literature review on social studies teachers and students perceived climate change, and subsequent research questions designed to best research the issue. Because of the complex exchanges between teachers‟ implementation of curriculum and student actions, and the variety of data available to document these interactions, including observations, interviews, and surveys, quantitative and qualitative data were collected to best capture these exchanges. Due to the complex nature of teachers and students‟ perceptions related to climate change and the limited amount of research that has been completed in the area, it was not clear how these perceptions influenced their classroom practice. Therefore, a set of three research questions were developed to better understand how social studies teachers and students perceives climate change, specifically how the social studies designed curriculum responds to climate change and what social studies teachers and students perceive as challenges in responding to climate change. It was necessary to use a mixed methods research approach due to the variety of data collected from teachers and students to fully understand the research questions of this study and to achieve triangulation within the research. The use of multiple research methods in examining the questions allowed me to examine the same dimension of a problem while discovering convergence of the data collected through the multiple methods.

A research approach using mixed methods is defined in as a study „„in which the researcher gathers both quantitative (closed-ended) and qualitative (open-ended) data, integrates the two and then draws interpretations based on the combined strengths of both sets of data to understand research problems"" (Creswell, 2014). A mixed methods approach to educational research utilizes both quantitative and qualitative methods in order to "draw from the strengths and minimize the weakness of both in single research studies" (Johnson & Onwuegbuzie, 2004). The strengths of my study include extrapolating data about social studies teachers" and students" perceptions of climate change through qualitative interviews and quantitative surveys. I also employed quantitative data collection methods to support understating and responds to perceived challenges of climate change by teachers and students and how social studies curriculum responds to climate change rather than using self-reported level of knowledge to determine this. This approach is a commonly used in education research and recognized for its practical implications that allow the researcher to assess meaning from the research study.

This indicates that quantitative and qualitative data was concurrently collected throughout the research process and both types of data were given equal status (Leech & Onwuegbzie, 2009). This design was used for this study because of the types of data collected, which consisted of both qualitative and quantitative. Within this study, equal status of both qualitative and quantitative types of data and both were held to the same regard. This was important for the process of analysis, as multiple forms of data were collected from teachers and students throughout the study. The other types are not appropriate, as they either gives dominant status to one type of method or are sequential in time order (Johnson & Onwuegbuzie, 2004).

The mixed methods design gives the researcher the option to carry out quantitative and qualitative approaches within or across all stages of the research (Johnson & Christensen, 2004). It is the decision of the researcher whether to emphasize one paradigm over the other, or give equal status to both approaches (Morgan, 1998; Morse, 1991). Another important consideration of a mixed method design is the time order of qualitative or quantitative phases; these phases can be carried out concurrently or subsequently (Johnson & Onwuegbuzie, 2004). Additionally, using a mixed methods approach incorporates conceptualization of the data for interpretation.

3.5 Research Design

This study utilized a type of concurrent design called the convergent parallel design of mixed methods. This design is often thought of as "triangulation" and was previously called the convergence model (Creswell, 2003). In this convergent parallel design, both quantitative and qualitative data were collected and independently analysed, then integrated and interpreted (Creswell & Plano Clark, 2011). Following the separate analysis of all quantitative and qualitative instruments, in a mixed methods study, the results are then merged and integrated to form inferences. Inferences in mixed methods research are conclusions or interpretations drawn from the separate quantitative and qualitative strands of the study as well as across the quantitative and qualitative strands (Creswell & Plano Clark, 2011).

Consequently, the trustworthiness of the findings could be enhanced because multiple sources and types of data made triangulation possible. For example, qualitative data from the interviews expanded on quantitative data from the survey. The quantitative approach employed the use of questionnaires while the qualitative approach employed semi-structured interviews to capture participants‟ experience of senior high school social studies teachers and students‟ perceived challenges and response to climate

change in Bolgatanga Municipality. The qualitative phase of this study uses thematic analysis to more fully understand the experience and quantitative phase uses percentages and tables. The rationale for this design is that the quantitative data and qualitative results provide a general picture of the research problem.

3.6 Population

The population consisted of all Social Studies teachers in the upper east region. The target population for this study consisted of all Senior High Schools (SHS) Social Studies teachers and form three students in the four SHS in the Bolgatanga Municipality during the period of the study. Since all the respondents involved in census surveys are all the members of a given population, the data is more comprehensive as it represents the views of everybody in the population. In all, 41 Senior High Schools (SHS) Social Studies teachers in the four (4) Senior High School and 122 form three students in the Bolgatanga Municipality made up the population for the study.

3.7 Sample and Sampling Procedure

Data gathering is very important in any research, since it helps to contribute to a better understanding of a phenomenon. Therefore, it then becomes important that the manner of obtaining data and from whom the data will be acquired be done with care. The sampling technique adopted for this study was census as used in this work implies collection of data from a whole population rather than just a sample. Purposive sampling, Kusi (2012) explains that it refers to the process of selecting special people usually to participate in a study on the basis of their knowledge on the issues being studied. The purposive sampling technique is the thoughtful choice of a participant due to the qualities the participant possesses. This involves identification

and selection of individuals or groups of individuals that are proficient and well-informed with a phenomenon of interest as well as the knowledge and experience they possessed. It makes it possible to decide what needs to be known and sets out to find people who can and are willing to provide the information by virtue of knowledge or experience.

Purposive sampling was connected with convenient sampling. Saunders, Lewis, Thornhill (2012) explained that convenience sampling (also known as availability sampling) is a specific type of non-probability sampling method that relies on data collection from population members who are conveniently available to participate in the study. Convenience sampling was used because, in addition to knowledge and experience, Palinkas, et al. (2015) note the importance of availability and willingness to participate, and the ability to communicate experiences and opinions in an articulate, expressive, and reflective manner should be of paramount consideration to the researcher. The idea behind purposive sampling is to concentrate on people with particular characteristics who will better be able to assist with the relevant research. In this study, Social Studies teachers were purposively selected because they posse particular characteristics that will assist in our analysis of information and drawing conclusions.

Purposive sampling technique was also employed in selecting a sample from the students. The technique was employed owing to the fact that the form three students had gone through the secondary school curriculum and were therefore best suited to test their knowledgeability of issues under study. The sample size for the students was arrived at using a formula by Nassiuma (2000): Where n= Sample size, N=

Population, Cv = Coefficient of variation (take 0.5) & e = Tolerance of desired level of confidence (0.05).

In order to gain access to the 128 respondents (students) the researcher used purposive and a convenience sampling method, through which the readily accessible students from the four schools were selected into the study sample. Even though known demerits of convenience sampling methods are appreciated, the study assumes that the motivation of students to study social studies stratifies them to have an opinion on climate change issues. The, the research proceeded from the assumption that the convenience sample was representative of the student population in so far as they have interests in environmental issues. Also, the fact that the three schools were double track makes it challenging to access all the students on the register at one point in time. This made the sampling method pragmatic to the researcher. The respondents were selected as they entered the classroom, upon which they were given a piece of paper with a check box to be completed. The researcher collected the papers, put them in group and mixed the pieces of paper with different colours in basket (red, yellow and green) and invited all the students who completed the check box paper to pick one colour-coded paper. All those who picked the green coloured paper were thus randomly selected for interviews. The simplicity of the method enabled the researcher to manage a sizeable number of the respondents as well as the process of sampling. Out of 128 participants each school had 32 respondents and 2 each were randomly selected for the interview.

Table 3.1: Sample size and sampling technique table for teachers and students

Category	Sampling technique	N=population	N=sample size	Percentage
Teachers	Census survey	44	44	100%
Students	Purposive/simple random	1828	128	10%

Source: Field Data: 2020

3.8 Data Collection Instruments

The cardinal research instrument used for the collection of data was questionnaires and interview guide. A survey strategy employing the use of questionnaire as instrument has distinct benefits. Questionnaire is a form of interrogation document which contains a systematically put together and well organised series of questions intended to elicit information which will provide intuition into the nature of the problem under study (Seidu, 2007). The main data collection instrument was a self-developed questionnaire which consisted of five sections, was used to solicit information on the teachers" and students of social studies. Section A consisted of personal data which in effect highlighted the degree of experience of the respondents as well as gender difference while sections B, C, D, and E catered for the teachers and students understanding of climate change, the causes of climate change as perceived by teachers and students, Social Studies curriculum responses to climate change, and the challenges Social Studies education confront in responding to climate change respectively.

Supplemental to this, the questionnaire was arrogated for the study subsequently in the views of McMillan and Schumacher (2001) a questionnaire is recommended if the researcher knows that the respondents will be capable to read, understand and answer the questionnaire.

When the right sample was selected the researcher triangulated the data collection methods by using standardized self-administered questionnaires with semi-structured interviews guide. While the questionnaire enabled the researcher to access commonalities in respondents, the semi-structured interviews allowed participants in-depth expression of their experiences, understanding and beliefs. A self-administered questionnaire was submitted (by hand) to twenty-five (128) respondents from the four schools: 32 to each of the schools. The interviews were conducted with two students each in a school, in which a semi-structured interview guide schedule was used. The semi-structured interviews were selected as the means of data collection because of two primary considerations. First, they are well suited for the exploration of the perceptions and opinions of respondents regarding to the issues of climate change. Interviews also have the potential to overcome the poor response rate of a questionnaire survey It is also a suitable method to explore the attitudes, values, beliefs. However, in case where the respondents could not put down the answer in writing, interviews and questionnaires complement each other. In terms of collecting data with interviews, it is a meaningful tool to use to understand deeply the emotions and perceptions with regard to climate change. The data collection process commenced on the beginning of January 2020. This was because of the availability of the students. For example, in one instance the interview of one of the respondents was postponed two times due to COVID19. Each interview took about 10 to 15 minutes, and the researcher interviewed a maximum of 1 participant per week, depending on their availability. The researcher audio-recorded the interviews, which were later transcribed for analysis. The gender balance was achieved by comparing the four institutions.

3.9 Validity and Reliability of Quantitative Instruments

Any score obtained by a measuring instrument is composed of both the "true" score, which is unknown, and "error" in the measurement process. The true score is essentially the score that a person would have received if the measurement were measured accurately. The objective of validating an instrument is in large part is to reduce error in the measurement process. It is the duty of the test developer to "identify the sources of measurement error that would be most detrimental to useful score interpretation and design a reliability study that reduces such errors in order to minimise their effects. To ensure that the instruments were valid and reliable, I gave them to my supervisors for their perusal and approval. The supervisors ascertained that face validity and content validity have been met. They suggested that certain corrections and changes be made in order to improve upon the instruments. Pretesting or pilot testing an instrument is one of the means for the minimisation of such errors. In this study pilot study was done for validity and reliability of the instruments. After the pilot study some of the items of the instruments were refined to improve measurement of variables.

3.10 Trustworthiness of Qualitative Instrument

In qualitative studies, trustworthiness is used to describe the stability of the study instead of reliability and validity. The data in this study and the research findings are transferable; meaning the findings in one setting can be transferred to similar settings. In addition, one way to show that qualitative research results are trustworthy is triangulation or comparing results "from different methods or groups on the same subject" (Joanna Briggs Institute, 2012, p. 133). The interview schedule was the same for each participant.

Responses and themes may have similar replies to explain each question in the questionnaire and in the interview guide (Lincoln & Guba, 1985). Lincoln and Guba (1985) expanded trustworthiness by including the terms credibility, transferability, dependability, and conformability. Each term is explained:

Credibility suggests that the readers are able to recognize the topic under investigation.

Transferability indicates that the findings are generalizable.

Dependability indicates the research is logical, able to be followed throughout, and is clearly documented.

Conformability suggests that researchers can ensure that findings are clearly derived from the data and the process of interpretation (Lincoln & Guba, 1985).

A pilot test of the questionnaire was conducted using 16 Social Studies teachers and 30 students drawn from Navsco SHS, St Johns" SHS, O.L.L, Girls SHS, Awe SHS and St Benedict SHS all in the Kasena/Nankana Municipal. It was revealed in the pilot study that some of the questions appeared ambiguous and teachers had difficulty in responding to them. Those statements were later reframed to make them more comprehensible.

The data assembled were coded into themes and conveyed onto Statistical Product for Service Solutions (SPSS) to analyse the data. The reliability was tested and establish to be reliable as maintained by Fraenkel and Wallen (2000) that if the co-efficient alpha value is 0.70 and above then the instrument is reliable and of good quality for collecting useful data for the study. The Cronbach"s alpha of .88 was established for

all sections of the questionnaire. Accordingly, the questionnaire was of good quality for collecting useful data for the study.

3.11 Data Collection Procedure

The administration of the instruments began in January, 2020. To facilitate administration of the instruments, a cover letter was issued by the head of the Social Studies Education Department to the Bolgatanga Municipal Director of Education and this was attached to the instruments. In addition to the letter issued by the department to the district the researcher organized a meeting with the Municipal Director of Education and her deputy to brief them on the purpose of the research and also to introduce myself to the district. The District Director and his team were very happy to the extent that the outcome of the research could impact on the future development of teachers in the district. To further enhance the relationship between the researcher and the respondents, an introductory letter from the Municipal Director of Education was issued requesting the headmasters to grant the researcher the necessary assistance. With the permission of the Headmasters, the Teachers (respondents) the researcher organized a meeting with the headmasters and the Social Studies teachers in clusters to brief them on the purpose of the research and also, afford them the opportunity to ask question for clarification. This helped to obtain the necessary support and cooperation. Some of the teachers questioned how they would be motivated. However, the researcher made them understand that the work was purely for academic purpose.

The questionnaires were distributed personally and respondents were allowed ample time to complete so that it could be retrieved easily for the purposes of analysis. In each school, the questionnaires were distributed personally and respondents were

informed that the completed questionnaire would be collected within one week and that completed items were to be handed over to the Head of Department for onward collection. This was to ensure that the teachers have ample time and also, help the researcher get the completed instruments even in the absence of the respondent for the purposes of analysis. With the student‟s questionnaire, students were organized by the researcher with the assistances of the social studies teachers to distribute the questionnaire to students to answer and collection done the same day the researcher and support from the social studies teacher in the various schools. A follow up visit to the schools helped the researcher to collect f (41) of the instruments representing 96% retrieval rate. This was achieved because the instruments were self-administered by the researcher

3.12 Data Analysis

The data gathered was analysed using the Statistical Product using Service Solutions (SPSS) and the interview conducted were also analysed. Because of the descriptive nature of the study, the researcher coded each questionnaire for identification before scoring them. In section A (the biographic data), frequency tables and percentages were used to complete information on respondents in order to ascertain the number of male and female who participated in the study as well as number of years in teaching, areas of specialization etc.

According to Glass and Hopkins (1996), descriptive statistics involves tabulating, depicting, and describing collections of data. The large masses of data collected would undergo a process of summarisation or reduction before they would become comprehensible. The data were organised into various themes and categories (four themes) based on the research questions and the purpose of the study such that each

section provide answers for each of the research questions. Prior to coding and tabulating the questionnaire for analysis, I checked all the items to see if instructions had been followed uniformly and whether all items had been responded to. The response to the questionnaires were then coded by assigning numbers to the various categories of responses for the purposes of analyses and were transferred to Statistical Package for Social Sciences (SPSS version 20).

The analyses were done based on frequencies and percentages for all the questions based on the objectives of the study. Views reflecting high frequencies and percentages were treated as the emerging opinion on the topic. I used frequencies and percentages because it gives a quick visual impression of the phenomena under study and are also easy to interpret. Qualitative data obtained was analysed using narratives in form of discussions and explanations. Programs used to conduct the analysis were; Statistical Package for Social Sciences (SPSS).

3.13 Ethical Issues

Again, ethical issues were addressed considering various precautionary measures. Teachers concerned received communication about their willingness to be selected to participate in the study. The questionnaire covered brief introduction, explaining the nature of the study and confirmation that the respondents are in control over the decision to complete questionnaire or not. The purpose and objectives of the study was clearly explained to the target respondents. With respect to confidentiality, only the researcher had the right of access to data. Also, the confidentiality of respondents‟ responses was explained to them in order to clear their doubts and fears.

With respect to the anonymity, respondent‟s privacy was guaranteed by ensuring that the identities of respondents were concealed during data collection in that respondents were not required to provide their names and telephone numbers on the questionnaire. The researcher picked a letter of introduction from the Social Studies Education Department which gave him clearance to go for data collection. The Director signed on the letter, copies were made and send headmasters/headmistresses in SHSs were sent by the researcher himself. This arrangement facilitated a smooth data collection process and led to greater co-operation among the researcher, headmasters/ headmistress and teachers.

CHAPTER FOUR

FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of the data analysis with regard to the teachers‟ and students‟ questionnaires. Descriptive statistics was used to delineate the basic features of the quantitative data from the questionnaires. The reason for using descriptive statistics was to solicit the views of social studies teachers and their students regarding climate change. Absolute numbers, frequencies and percentages were used to present the results and findings from the teachers‟ questionnaires. On the other hand, the results from the students‟ questionnaire were also presented using absolute numbers and percentages.

The results of the study are presented in five sections; section one presents the response rate of the study and each of the remaining four sections focuses on the research questions of the study. The outline of the chapter is as follows:

i. Response rate of the study
ii. Demographic Profile of Respondents
iii. The level of understanding of Social Studies teachers and students about Climate Change
iv. How social studies curriculum responds to climate change
v. Teachers‟ perception about the challenges social studies education faces in responding to climate change

4.2 The Response Rate of the Study

This section of the chapter presents the analysis and discussions of the response rate of the study. Based on the research design of this study a total of 172 respondents (44

teachers and 128 students) were supposed to be covered, but 163 respondents were covered instead representing 94.8%. The 44 teachers comprise of two groups; the first group consist of the teachers (40) who were purposely selected to respond to the study"s questionnaire while the second group were the teachers (4) who were selected to have a face to face interview with researcher on the study"s research questions. On the other hand, the 128 students consist of the questionnaire group (120) and the face to face interview cohort (8). It is significant to state that, all the teachers and students who were schedule to have the face to face interview responded to the study. However, with the questionnaire group, 3 teachers and 6 students did not respond to the study. This represents 5.2% of the entire respondents (172) and it can be observed from table 4.1. Their reasons were confidential, and these confidential reasons were not revealing to the researcher. The results presented from section 4.3 to 4.7 are limited or constitute the responses from questionnaire cohort (both teachers and students).the response rates were considered adequate because they exceeded 65% level set, assuming a limited response bias, sampling error and a reasonable degree of homogeneity in the sample.

Table 4.1: Response rate of the study

Response	Teachers	Students	Total	Percentages
Accessible	41	122	163	94.8%
Inaccessible	3	6	9	5.2%
Total	**44**	**128**	**172**	**100.0%**

Source: Field survey, July, 2020

4.3 Demographic Profile of Respondents

This section of the chapter presents the analysis and discussions of demographic profile of respondents in this study.

4.3.1 Teachers profile

4.3.1.1 Results on the gender of the teachers

Table 4.2 shows the gender distribution of the teachers. Out of the 41 teachers sampled, majority (56.10%) of them were males. Meanwhile, 43.90% of the respondents constitute females. These revelations were not surprising because the Bolgatanga Municipal Educational Directorate database confirm that males dominate the teaching of social studies in the secondary schools. This shows gross-under-representation of females in top management and policy-making position. This situation is attributed to the existence of social, cultural and structural barriers of effective female participation. Therefore, we should encourage gender balance in labour force.

Table 4.2: Results on the gender of the teachers

Sex	Frequency	Percentages
Male	23	56.10%
Female	18	43.90%
Total	**41**	**100.00%**

Source: Field survey, 2020

4.3.1.2 Result on the teachers qualification

This sub section of the study highlights the academic qualification of the social studies teachers who were involve in the study. Majority (75.61%) of the teachers hold various forms of bachelor degree, only one (1) person holds Diploma. However, 19.51% of the respondents have master‟s degree. The results obtained in Table 3 were consistent with the Bolgatanga Municipal Education directorate data, which indicates that all social studies teachers in the municipality have completed Tertiary education. Essentially, the teachers‟ subject area of specialization were also sought and the results can be obtained from Figure 4.1. Most (67.5%) of the teachers‟

subject area of specialization is social studies.

Table 4.3: Result on the teachers qualification

Qualifications	Frequency	Percentages
Diploma	1	2.44%
Degree	31	75.61%
Post-graduate diploma	1	2.44%
Masters	8	19.51%
Post-graduate diploma	0	0.00%
PhD	0	0.00%
Total	**41**	**100.00%**

Source: Field survey, July, 2020

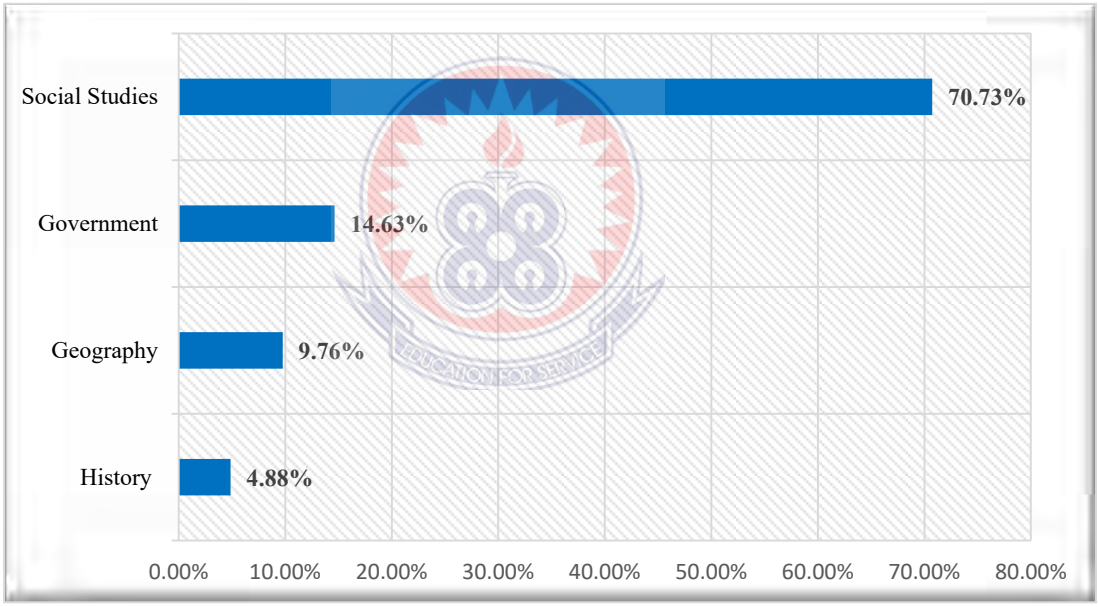

Figure 4.1: Results on subject area of specialization of the Teachers

Source: Field survey, July, 2020

4.3.1.3 Teachers number of years of teaching Social Studies

Teachers experience in teaching the subject, social studies is very crucial because it helps to effectively assess the extent to which the subject‟s syllabus responds to climate change. In view of this, the respondents (teachers) were probed to indicate the number of years that they had taught Social Studies in their teaching career. The

Results from Table 4.4 indicates that majority (60.98%) of the teachers had taught between 1-5 years. Also about 39.02% of the teachers had taught for a minimum of six years. As maintained by Gatbonton (1999) that most commonly experienced teachers are those who have approximately five years or more of classroom experience. This presupposes that in terms of number of years, if one works in a particular field of endeavour for five years, all other things being equal, it means the person is experienced. The findings from this study clearly show that social studies teachers in the Bolgatanga Municipal are experienced. Therefore, implies that they are well vest in the social studies curriculum, pedagogical and content knowledge when it comes to climate change content and issues.

Table 4.4: Number of years of teaching Social Studies

Period (Years)	Frequency	Percentages
1-5	25	60.98%
6 -10	8	19.51%
11 -15	6	14.63%
16-20	2	4.88%
More than 20 years	0	0.00%
Total	**41**	**100.00%**

Source: field survey, July, 2020

4.3.2: Students profile

4.3.2.1: Results on the gender of the students

Figure 4.2 shows the Gender distribution of the students. Out of the 122 students who responded to the study, majority (65.57%) of them were Females. Meanwhile, 34.43% of the respondents constitute males. These revelations were expected because out of the four SHS schools that were considered for the study, one (1) among them is a girls‟ school. Table 4.5 presents the various category of the schools in the Bolgatanga

municipality. Out of the sample (122) of the study, 77.05% represents the mixed schools while 22.95% constitute the girls school. This implies that there more females in various learning institutions because of encouragement and motivation given to females through scholarships for them to enrol in schools to achieved gender balance in the schools.

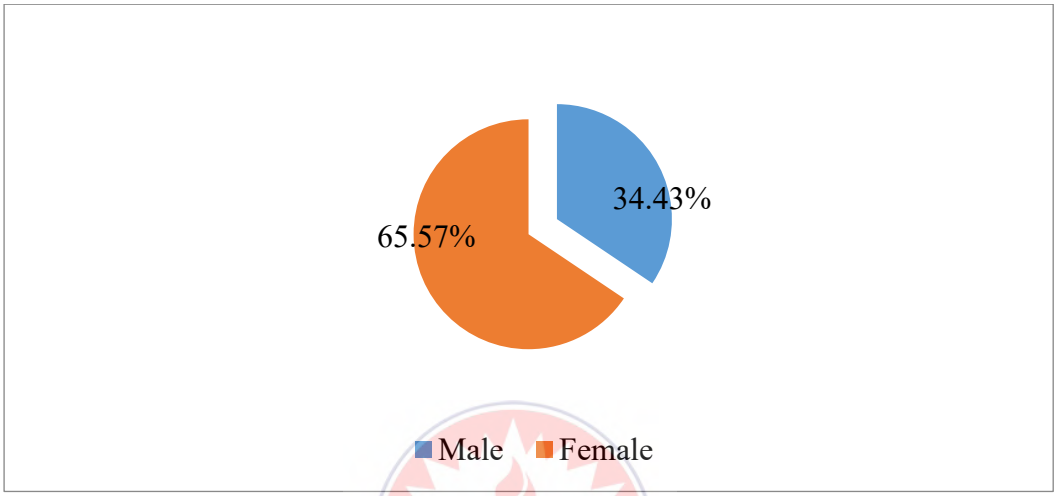

Figure 4.2: Results on gender of the students

Source: field survey, July, 2020

Table 4.5: Results on students' school category

School type	Frequency	Percentages
Boys only	0	0.00%
Girls only	28	22.95%
Mixed (Boys & Girls)	94	77.05%
Total	**122**	**100.00%**

Source: field survey, July, 2020

4.3.2.2 Results on Students age

From the Table 4.6, the study established that majority (84.43%) of the students ranged between 16 and 18 years. Students between the age brackets 14 to 16 years constitute 11.48% and those above 18 years represents 4.10%. However, it can be observed from Table 6 there were no students who are less than 14years.

Table 4.6: Distribution of students' age group

Age	Frequency	Percentages
Below 14	0	0.00%
14 -16	14	11.48%
16 -18	103	84.43%
Above 18	5	4.10%
Total	**122**	**100.00%**

Source: field survey, July, 2020

4.4 Level of Understanding of Teachers and Students about Climate Change

4.4.1 Teachers' understanding about the meaning of climate change

This section presents the responses from teachers regarding their level of understanding about the meaning of climate change. The 3-point scale used were (Note: 1=Uncertain, 2= Disagree, 3= Agree)**.** The teachers were asked to indicate whether or not they agree, disagree or uncertain to the eleven (11) definitions highlighted in table 4.7 vis-à-vis the meaning of climate change. The results from Table 7 indicates that most (70.3% - 97.3%) of the teachers agreed to all with the exception of one of the statements or definitions of climate change. Generally, the results from the study suggests that the Social Studies teachers have, to a large extent, irreplaceable knowledge about the meaning of climate change.

However, most (83.8%) of the respondents (teachers) disagree to the definition, "anything about the weather is climate change. The finding of the study is consistent with Anthropogenic Theory and what bodies like the IPCC (2007) and UNFCCC (2007) had proposed regarding the meaning of climate change. Also, 33 (89.2%) of the teachers in this study agreed that Climate change is driven by human activities. According to Intergovernmental Panel on Climate Change (IPCC, 2007), climate change means the alteration of the world,,s climate that we humans are causing, through fossil fuel burning, clearing forests and other practices that increase the concentration of Greenhouse Gases (GHG) in the atmosphere. This is similar to the

official definition by the United Nations Framework Convention on Climate Change (UNFCCC, 2007) that climate change is the change that can be attributed directly or indirectly to human activity that alters the composition of the global atmosphere.

Hamilton (2008) said that climate change is largely influenced by political issue. He argued that political orientation is a stronger determinant of attitudes towards climate change than other demographic attributes. The politicization of the debate on climate change has led members of the public to perceive it more as a matter of personal opinion or a political ideology, distracting attention from the known facts about climate change and the basic causes of those changes (Furman, Roncoli, Crane, Paz JO, Hoogenboom, 2009). The results of this this study affirms to this proposition. Majority (70.3%) of the teachers agreed that climate change is a political issue or ideology. This presupposes that the issue of climate change is a worldwide phenomenon that needs a mutually concerted effort from all world leaders than to pursue it from individual political viewpoint or orientation.

Resolving the problems caused by climate change through education is one of the fundamental ways by which it could easily be done. From the above findings, it can be inferred that the required knowledge for teaching climate change is not a problem if it is included in the curriculum as an explicit topic (instead of being subsumed under the topic “Our Physical Environment” in the curriculum

Table 4.7: Teachers' understanding about the meaning of climate change

Codes	Statement	N	Uncertain	Disagree	Agree
Q11	Climate change is the alteration of the world‟s climate	37	1 (2.7%)	2 (5.4%)	34 (91.9%)
Q12	Global warming is a sign of climate change	37	1 (2.7%)	5 (13.5%)	31 (83.8%)
Q13	Melting of ice is an indication of climate change	37	4 (10.8%)	1 (2.7%)	32 (86.5%)
Q14	Desertification is partly the result of climate change	37	2 (5.4%)	0.0%	35 (94.6%)
Q15	Change in the pattern of rainfall is climate change	37	1 (2.7%)	4 (10.8%)	32 (86.5%)
Q16	Climate change is driven by human activities	37	2 (5.4%)	2 (5.4%)	33 (89.2%)
Q17	Climate change is natural	37	6 (16.2%)	5 (13.5%)	26 (70.3%)
Q18	Climate change is a political issue	37	5 (13.5%)	6 (16.2%)	26 (70.3%)
Q19	Climate change is a worldwide phenomena	37	1 (2.7%)	0.0%	36 (97.3%)
Q20	Rise in sea level is the result of climate change	37	1 (2.7%)	1 (2.7%)	35 (94.6%)
Q21	Anything about the weather is climate change	37	3 (8.1%)	31 (83.8%)	3 (8.1%)

Source: Field survey, July, 2020

4.4.2 Students' understanding about the meaning of climate change

In addition to establishing teachers‟ understanding about the Meaning of Climate Change, students were also asked to specify whether or not they agree, disagree or uncertain to the eleven (11) definitions subjected to climate change. The results from the students is contrarily to the teachers responses. Majority of the students were uncertain with most of the various definitions of climate change. However, majority 67 (58.8%) of the students agreed that Climate change is the alteration of the world‟s climate. Also 49.1% of the students confirmed that Climate change is driven by human activities. The revelation from the figures implies that students had low knowledge when it comes to climate change and its related content, and therefore,

needs to be encourage to form and belong to climate change clubs and associations to boost their knowledge of climate change issues and content.

Table 4.8: Students' understanding about the meaning of climate change

Codes	Statement	N	Uncertain	Disagree	Agree
Q4	Climate change is the alteration of the world"s climate	114	42 (36.8%)	5 (4.4%)	67 (58.8%)
Q5	Global warming is a sign of climate change	114	55 (48.2%)	12 (10.5%)	47 (41.2%)
Q6	Melting of ice is an indication of climate change	114	72 (63.2%)	9 (7.9%)	33 (28.9%)
Q7	Desertification is partly the result of climate change	114	79 (69.3%)	12 (10.5%)	23 (20.2%)
Q8	Change in the pattern of rainfall is climate change	114	79 (69.3%)	2 (1.8%)	33 (28.9%)
Q9	Climate change is driven by human activities	114	53 (46.5%)	5 (4.4%)	56 (49.1%)
Q10	Climate change is natural	114	79 (69.3%)	7 (6.1%)	28 (24.6%)
Q11	Climate change is a political issue	114	74 (64.9%)	30 (26.3%)	10 (8.8%)
Q12	Climate change is a worldwide phenomena	114	88 (77.2%)	12 (10.5%)	14 (12.3%)
Q13	Rise in sea level is the result of climate change	114	95 (83.3%)	5 (4.4%)	14 (12.3%)
Q14	Anything about the weather is climate change	114	65 (57.0%)	2 (1.8%)	47 (41.2%)

Source: Field survey, July, 2020

4.5 Results on Teachers' Perception Regarding Causes of Climate Change

It was prudent to solicit Social Studies teachers" perspective about the causes of climate change since they are the implementers of the subject"s curriculum. In this section the responses elicited from the teachers were in two folds **1.** Teachers" Perception Regarding the Causes of Climate Change, **2.** Teachers" percentage rating on how the factors causes climate change. The outcomes were presented in Table 4.9a and 4.9b respectively.

The study revealed the following; excess carbon dioxide in the atmosphere), Chlorofluorocarbons, depletion of the ozone layer, burning of fossil fuel, variation in the sun,,s energy, cutting-down of trees, bush burning and building of cities, Irrigation of desert and Volcanic eruption as the causes of climate change. From the result, majority (73% to 94%) of the teachers agreed to all factors highlighted in table 4.9a as the causes of climate change. However, few of the teachers were either disagree or uncertain to the factors. The results show that, 29 (78.4%) of the teachers agreed that Volcanic eruption causes climate change. The teachers were subjected to why volcanic eruption is a cause factor to climate change. The reason given was that volcanoes can impact climate change. Majority of them said during major explosive eruptions huge amounts of volcanic gas, aerosol droplets, and ash are injected into the stratosphere. Injected ash falls rapidly from the stratosphere, most of it is removed within several days to weeks and has little impact on climate change. But volcanic gases like sulfur dioxide can cause global cooling, while volcanic carbon dioxide, a greenhouse gas, has the potential to promote global warming. This result was inconsistent with Baker (2015) findings, which says that volcanic eruption is not factor that cause climate change.

It is significant to state that, while there has been some controversy in the past that natural variability observed over comparable time periods was a factor in causing climate change, it is now widely accepted that human activities, in particular fossil fuel use and changing land-uses, are the dominant factors in this growth and are responsible for most of the warming observed over the past 50 years (IPCC, 2007; UNFCCC, 2007).Verlag and Muller (1992) said that the major among the causes of climate change are greenhouse gases which result mainly from human activities. They

further stated that, globally the use of fossil fuels, coal, oil and gas for energy purpose accounts for 50% of the additional man-made greenhouse effect.

Table 4.9a: Teachers' perception regarding the causes of climate change

Codes	Statement	N	Uncertain	Disagree	Agree
Q22	Excess $C0_2$ in the atmosphere	37	2 (5.4%)	0.00%	35 (94.6%)
Q23	Chlorofluorocarbons	37	6 (16.2%)	1 (2.7%)	30 (81.1%)
Q24	Depletion of the ozone layer	37	1 (2.7%)	1 (2.7%)	35 (94.6%)
Q25	the burning of fossil fuel	37	2 (5.4%)	4 (10.8%)	31 (83.8%)
Q26	Variation in the sun"s energy	37	2 (5.4%)	2 (5.4%)	33 (89.2%)
Q27	Ocean circulation (current)	37	6 (16.2%)	4 (10.8%)	27 (73.0%)
Q28	Cutting –down of trees and bush burning	37	5 (13.5%)	0.00%	32 (86.5%)
Q29	Building of cities	37	2 (5.4%)	5 (13.5%)	30 (81.1%)
Q30	Irrigation of desert	37	7 (18.9%)	2 (5.4%)	28 (75.7%)
Q31	Volcanic eruption	37	7 (18.9%)	1 (2.7%)	29 (78.4%)

Source: Field survey, July, 2020

Moreover, the teachers who agreed to the factors that causes climate change, were further asked to rate the degree of cause of those factors highlighted in table 4.9a and 4.9b. Majority of the teachers rated the degree of cause of all the factors as "high". It can be obtained from table 4.9b that, out of the agreed responses, 9 (32.1%) rated the degree at which Irrigation of desert causes climate change as "higher". Pielke Sr (2009), Travis (2007), Matsui and Pielke Sr (2006) have alluded to this fact in Bast„s (2013) book entitled Seven Theories of Climate Change. International bodies such as National Research Council, Intergovernmental Panel on Climate Change and United Nations Framework Convention on Climate Change have published extensively on

climate change in which irrigation of desert features as one of the causes. Also 6 (20.0%) rated the cause of climate change due to Building of cities as "higher"

Table 4.9b: Teachers' perception regarding the magnitude of the causes of climate change

Codes	Statement	N	Highest	Higher	High
Q22	Excess C02 in the atmosphere	35	1 (2.9%)	6 (17.1%)	28 (80.0%)
Q23	Chlorofluorocarbons	30	0.00%	2 (6.7%)	28 (93.3%)
Q24	Depletion of the ozone layer	35	2 (5.7%)	6 (17.1%)	27 (77.1%)
Q25	The burning of fossil fuel	31	5 (16.1%)	5 (16.1%)	21 (67.7%)
Q26	Variation in the sun"s energy	33	1 (3.0%)	6 (18.2%)	26 (78.8%)
Q27	Ocean circulation (current)	27	2 (7.4%)	2 (7.4%)	23 (85.2%)
Q28	Cutting –down of trees and bush burning	32	4 (12.5%)	2 (6.3%)	26 (81.3%)
Q29	Building of cities	30	2 (6.7%)	6 (20.0%)	22 (73.3%)
Q30	Irrigation of desert	28	0.00%	9 (32.1%)	19 (67.9%)
Q31	Volcanic eruption	29	2 (6.9%)	4 (13.8%)	23 (79.3%)

Source: Field survey, July, 2020

4.6 Results on Students' Perception Regarding Causes of Climate Change

This subsection of the study presents students" Perception Regarding the Causes of Climate Change as well as their percentage rating on how the factors causes climate change. The results were presented in Table 4.10a 4.10b respectively. When one juxtaposes the students" responses on the Causes of Climate Change to the meaning of climate change (see Table 4.8) you will be left with only one conclusion, that students level of understanding of the meaning of climate is low as compare to their perception regarding the causes of climate change. However, Majority of the students agreed

with all the Causes of Climate Change. Nevertheless, some of the students were uncertain.

Table 4.10a: Students' perception regarding the causes of climate change

Codes	Statement	N	Uncertain	Disagree	Agree
Q15	Excess C02 in the atmosphere	114	19 (16.7%)	0.00%	95 (83.3%)
Q16	Chlorofluorocarbons	114	30 (26.3%)	0.00%	84 (73.7%)
Q17	Depletion of the ozone layer	114	30 (26.3%)	0.00%	84 (73.7%)
Q18	The burning of fossil fuel	114	7 (6.1%)	0.00%	107 (93.9%)
Q19	Variation in the sun‟s energy	114	21 (18.4%)	2 (1.8%)	91 (79.8%)
Q20	Ocean circulation (current)	114	23 (20.2%)	0.00%	91 (79.8%)
Q21	Cutting –down of trees and bush burning	114	0.00%	0.00%	114 (100.0%)
Q22	Building of cities	114	0.00%	0.00%	115 (100.0%)
Q23	Irrigation of desert	114	7 (6.1%)	0.00%	107 (93.9%)
Q24	Volcanic eruption	114	5 (4.4%)	0.00%	109 (95.6%)

Source: Field survey, July, 2020

However, the students who agreed to the factors that causes climate change, were further asked to rate the degree of cause of those factors. Majority of the teachers rated the degree of cause of all factors as "high". It can be obtained from table 4.5b that, out of the agreed responses, 60 (52.6%) rated the degree of cause of Cutting down of trees and bush burning as "higher". Also 63 (55.3%) rated the degree of cause of Building of cities as "higher".

Table 4.10b: Students' perception regarding the magnitude of the causes of climate change

Codes	Statement	N	Highest	Higher	High
Q15	Excess C02 in the atmosphere	95	0.00%	41 (43.2%)	54 (56.8%)
Q16	Chlorofluorocarbons	84	0.00%	30 (35.7%)	54 (64.3%)
Q17	Depletion of the ozone layer	84	0.00%	34 (40.5%)	50 (59.9%)
Q18	The burning of fossil fuel	107	2 (1.9%)	38 (35.5%)	67 (62.6%)
Q19	Variation in the sun"s energy	91	0.00%	33 (36.3%)	58 (63.7%)
Q20	Ocean circulation (current)	91	0.00%	34 (37.4%)	57 (62.6%)
Q21	Cutting –down of trees and bush burning	114	3 (2.6%)	60 (52.6%)	51 (44.7%)
Q22	Building of cities	114	0.00%	63 (55.3%)	51 (44.7%)
Q23	Irrigation of desert	107	0.00%	51 (47.7%)	56 (52.3%)
Q24	Volcanic eruption	109	0.00%	56 (51.4%)	53 (48.6%)

Source: Field survey, July, 2020

4.7 How Social Studies Curriculum Responds to Climate Change

4.7.1 Results teachers responses on how social studies curriculum response to climate change

This sub-section considers Teachers Responses on how Social Studies Curriculum Response to Climate. The 4-point scale used were (Note: **1**=Not At All, **2**=Not Sure, **3**=Some-how, **4**=To a Large Extent). It can be observed that there is vary response for each of the items highlighted in table 4.11. Majority (48.6%) of the teachers believed that the Social Studies curriculum addresses climatic issues to a large extent. Few (18.9%) were uncertain as to whether the curriculum addresses climatic change. However, out of the 37 teachers, 12 (32.4%) believe the curriculum some-how helps to response to climate change. The choice of the word to somehow implies that the curriculum is not fully equipping the learners on the issues of climate change. Moreover, some (35.1%) of the teachers believe that Social Studies curriculum would

better respond to climate change if it is designed by teachers themselves. This assertion made was opposed by 14 (37.8%) of the teachers.

Regarding whether the curriculum would better respond to climate change if we use foreign Social Studies curriculum or books, an overwhelming majority (73.0%) of teachers said not at all. Ironically, 18.9% believe that to a large extent foreign Social Studies curriculum would help respond to climate change better. Laessoe, et al. (2009) said that climate change education is still in its infancy. Notwithstanding this assertion, some countries have made impressive moves towards the inculcation of climate change issues into their educational systems. The Chinese government, for example, was one of the first countries to formulate and carry out a strategy for sustainable development and adopted climate change action plans after the United Nations Conference on Environment and Developmentin1992. On the contrary, casual observation shows that Ghana has not made much effort in this direction though there have been national calls to reduce human activities, especially, the burning of fossil fuels (e.g. coal and oil) which intensify climate change (Evans, 2004). The Ghana national climate change policy also appears to be silent on curriculum effort that is needed to transform the knowledge base of learners in the country.

From Table 4.11, 28 (75.7%) of the teachers agreed to a large extent that the Social Studies curriculum should be redesigned to better handle issues of climate change. This is a clarion call, and Ghana could replicate China,s example which include specific education initiatives where knowledge about climate change is included in basic, higher and adult education with a focus on awareness and participation in relevant activities (Yi & Wu, 2009). As proclaimed in the National Climate Change Policy (2013), Ghana could integrate and scale up its education efforts on climate

change by drawing on its successful tactics in other sectors, such as health education. This is very essential in the sense that the recent discovery and exploration of crude oil in Ghana imposes certain demands on the environment through water pollution and gas flaring, which also pollutes the air. These, added to the pre-existing environmental problems are likely to aggravate the situation as maintained by Boadu and Oden (2013) and consequently lead to climate change.

Table 4.11: Teachers responses on how Social Studies curriculum response to climate change

Codes	Statement	N	Not At All	Not Sure	Some-how	To a Large Extent
Q32	The Social Studies curriculum is addressing climate change	37	0.00%	7 18.9%)	12 (32.4%)	18 (48.6%)
Q33	The Social Studies curriculum is helping teachers to handle climate issues sufficiently	37	4(10.8%)	6(16.2%)	16(43.2%)	11 (29.7%)
Q34	The Social Studies curriculum is increasing people"s knowledge on climate change	37	5(13.5%)	5(13.5%)	10(27.0%)	17 (45.9%)
Q35	The Social Studies curriculum is positively changing students views about climate change	37	0.00%	4(10.8%)	9(24.3%)	24 (64.9%)
Q36	The Social Studies curriculum should be redesigned to better handle issues of climate change	37	1 (2.7%)	2 (5.4%)	6 (16.2%)	28 (75.7%)
Q37	The Social Studies curriculum would better respond to climate change if it is designed by teachers themselves	37	14(37.8%)	4(10.8%)	6 (16.2%)	13(35.1%)
Q38	The Social Studies curriculum would better respond to climate change if we use foreign Social Studies curriculum or books	37	27(73.0%)	2 (5.4%)	1 (2.7%)	7 (18.9%)

Source: Field survey, July, 2020

4.7.2 Teachers responses on the topics in the social studies syllabus that addresses climate change

Figure 4.3 displays teachers Responses on the topics in the social studies syllabus that addresses climate change. It can be obtained from Figure 4.4 that not all the teachers agreed to the topics that is believe can address climate change. However, majority (89.19%) of the teachers indicates that "Our Physical Environment and Environmental Challenges" is in social studies syllabus to address climate change. With regards to "Sustainable Development", only 16.22% of the respondents believed the said topic in the syllabus. Also, "Science and Technology" recorded 27.03% of the agreed responses. A keen analysis of the Social Studies syllabus depicts its lack of intensive touch on climate change. There is no particular topic on climate change alone. This is highly inadequate and makes the call that one of the fundamental ways through which the younger generation can internalise issues of climate change is Social Studies education to make them climate sensitive and ensure sustainable future might not be realised.

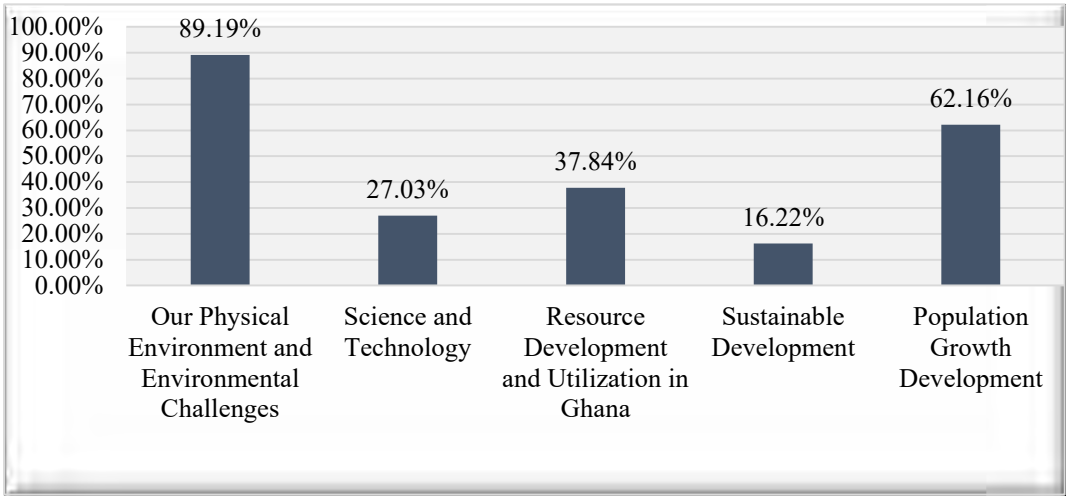

Figure 4.3: Results on topics in the social studies syllabus that addresses climate change

Source: Field survey, July, 2020

4.8 Teachers Perception about the Challenges Social Studies Education faces in Responding to Climate Change

This section presents the teachers‟ perspective about the Challenges that Social Studies Education Face in Responding to Climate Change and the degree of the challenges. The results were presented in Table 4.12a and 4.12b respectively. Most (70.3% - 86.5%) of the teachers agreed to the following challenges ; Inadequate TLMs for teaching climate change, Unavailable of resource persons, Social Studies curriculum is overloaded with other issues, Abstract nature of the causes of climate change, Difficulty in communicating climate change issues to the students, Centralization of the curriculum, Inadequate curriculum designers‟ knowledge on climate change, Inadequate teacher‟s knowledge on climate change, Politicization of the debate on climate change, Because the effect of climate change has not been sufficiently yet, Financial constraint, Poverty. However, some (2.7% to 13.5%) of the teachers disagreed to the challenges.

These factors are real and throw a challenge to stakeholders of our educational system to revamp the curriculum by first dealing with the challenges cited above. For example, it is now made clear by the teachers that because the effects of climate change have not been sufficiently felt yet by individuals that is perhaps, why we are paying lips service and not showing much commitment. Most of the challenges exposed by the teachers have their roots in the financial constraint that they emphasised. In teaching the little aspects of climate change that appear under some topics in the syllabus, teachers do not have access to teaching-learning resources resulting in abstract teaching and learning of the concepts that require concrete materials and resource persons. Development and/or redesigning of curriculum either

by innovation or reform comes with financial commitment that poses a greater challenge as suggested by the Social Studies teachers.

It is argued that although the role of education in addressing the challenges of climate change is being increasingly recognised, the capacity of education to contribute to adaptation and mitigation measures has yet to penetrate mainstream development thinking. In practical terms, the integration of climate knowledge and skills into existing education systems represents both immediate and longer-term challenges for responding to climate change (UNESCO, 2012). Again, history shows that society has successfully coped with and adapted to the existing relatively stable climate variability; the challenge now is to respond effectively to the threats presented by climate change (NRC, 2010b). All types of decision-makers (e.g. governments, businesses, and individuals) are already taking actions to respond to climate change (NRC, 2010c). However, large segments of society still remain unconvinced that climate change is real (Kohut, Doherty, Dimock & Keeter, 2009) and, therefore, these segments remain inactive. This buttresses the point that it appears the effects of climate change has not been sufficiently felt yet. This therefore, implies that curriculum desgners and stakeholders to critical examine amount of climate change content in the social studies curriculum if we to achieve the results of combating climate change.

Table 4.12a: Teachers perception about the challenges Social studies education faces in responding to climate change

Codes	Statement	N	Uncertain	No	Yes
Q42	Inadequate TLMs for teaching climate change	37	5 (13.5%)	2 (5.4%)	30 (81.1%)
Q43	Unavailable of resource persons.	37	6 (16.2%)	5 (13.5%)	26 (70.3%)
Q44	Social Studies curriculum is overloaded with other issues	37	7 (18.9%)	1 (2.7%)	29 (78.4%)
Q45	Abstract nature of the causes of climate change	37	5 (13.5%)	4 (10.8%)	28 (75.7%)
Q46	Difficulty in communicating climate change issues to the students	37	7 (18.9%)	4 (10.8%)	26 (70.3%)
Q47	Centralization of the curriculum	37	6 (16.2%)	2 (5.4%)	29 (78.4%)
Q48	Inadequate curriculum designers knowledge on climate change	37	6 (16.2%)	0.00%	31 (83.8%)
Q49	Inadequate teacher"s knowledge on climate change	37	4 (10.8%)	1 (2.7%)	32 (86.5%)
Q50	Politicization of the debate on climate change.	37	6 (16.2%)	1 (2.7%)	30 (81.1%)
Q51	Because the effect of climate change has not been sufficiently yet.	37	2 (5.4%)	6 (16.2%)	29 (78.4%)
Q52	Financial constraint	37	6 (16.2%)	4 (10.8%)	27 (73.0%)
Q53	Poverty	37	3 (8.1%)	4 (10.8%)	30 (81.1%)

Source: Field survey, July, 2020

Table 4.12b: Teachers perception about the magnitude of the challenges Social Studies education faces in responding to climate change

Codes	Statement	N	Greatest	Greater	Great
Q42	Inadequate TLMs for teaching climate change	30	2 (6.%)	8 (26.7%)	20 (66.7%)
Q43	Unavailable of resource persons.	26	1 (3.8%)	9 (34.6%)	16 (61.5%)
Q44	Social Studies curriculum is overloaded with other issues	29	5 (17.2%)	6 (20.7%)	18 (62.1%)
Q45	Abstract nature of the causes of climate change	28	1 (3.6%)	9 (32.1%)	18 (64.3%)
Q46	Difficulty in communicating climate change issues to the students	26	2 (7.7%)	9 (34.6%)	15 (57.7%)
Q47	Centralization of the curriculum	29	1 (3.4%)	8 (27.6%)	20 (69.0%)
Q48	Inadequate curriculum designers knowledge on climate change	31	2 (6.5%)	6 (19.4%)	23 (74.2%)
Q49	Inadequate teacher‟s knowledge on climate change	32	2 (6.3%)	10 (31.3%)	22 (62.5%)
Q50	Politicization of the debate on climate change.	30	4 (13.3%)	5 (16.7%)	21 (70.0%)
Q51	Because the effect of climate change has not been sufficiently yet.	29	0.00%	6 (20.7%)	23 (79.3%)
Q52	Financial constraint	27	0.00%	7 (25.9%)	20 (74.1%)
Q53	Poverty	30	4 (13.3%)	5 (16.7%)	21 (70.0%)

Source: Field survey, July, 2020

Discussion of Interviews from the four Institutions

The majority of the respondents believed that climate change is happening at both global and local levels, and would lead to adverse impacts. They strongly agreed that agricultural production, population health and natural ecology had already been affected by climate change in their jurisdiction, with more extreme weather events. The findings are consistent with other studies (IPCC, 2007a, 2012; Ju et al., 2013; Luber & McGeehin, 2008; Maibach et al., 2008; WHO, 2003).

All respondents from the four institutions seemed to appreciate climate change as a global problem. However, two (2/3) of the respondents from the four institutions seemed to subscribe to the argument that human activity was the major cause of climate change, a belief espoused by the Anthropogenic school of thought. Only one respondent from the four respondents appreciated the contributions of both human activities and natural causes in climate change. All respondents from the four institutions agreed that human activities can bring about changes in the climate beyond the natural variation that takes anyway. This was largely seen as resulting from several activities by human beings: burning of fossil fuels; C02 emission, emission from industry, natural variation, deforestation etc.

The majority of the interviewees from the four institutions claimed to have had personal experience of the effects of climate change, even though they only limited climate change effects to drought and occasional flooding. The respondents asserted hearing a lot about climate change even before this survey. The respondents also saw effects of climate change as destruction of human live hoods and the ultimate loss of natural resources. All these were seen as having huge financial implications on human societies, particularly with the possible increase in poverty levels illnesses. As can be imagining, the children, poor people as well as aged were seen as the most likely to be badly affected victims of climate change.

The impacts of climate change on people especially those bin Africa are enormous. The IPCC (2013) has uncovered the vulnerability of African countries to climate change in respect of floods, disaster and many others. In addition, more than three quarters of respondents were aware of the threat to infectious diseases due to climate

change in their jurisdiction. These findings indicate respondents had widespread awareness towards climate change and its immediate threat to human society

Most respondents also claimed to have enough information on climate change to make opinion. This study shows that internet, television, books, radio and newspapers were the main sources of information about climate change. The results are similar to a previous study conducted in Australia to assess awareness towards heat waves among a cohort of residents (Akompab et al., 2013).

The scientific literature indicates that natural causes are very unlikely to explain most observed global warming, and that human activities have made great contributions (IPCC, 2007b; Santer et al., 2013b). In this study, respondents considered the main reasons for climate change to be related to an increase in motor vehicles, serious pollution, destruction of forest and farmland, changes in the atmosphere, the greenhouse effect, rapid development of industry, population growth and environmental deterioration. These findings extend, and are largely consistent with, recent studies of human influences on the changing thermal structure of the atmosphere (Doney, 2010; Lu and Liu, 2014; Santer et al., 2013a). Most of these human activities, either directly or indirectly result in increasing concentrations of greenhouse gases in the atmosphere and further increasing negative impacts of climate change (Ebi, 2013).

Majority of them claimed that they got their information on climate change from trusted sources. Only one out of the four respondents claimed he aware of organization which is in climate change, the majority of the respondents are not aware of such organizations.

In addition to the efforts from each individual, addressing climate change will require cooperation and collaboration among international communities through the participation of local and international organizations. Majority of the respondents were of the view that the panacea for tackling of climate change is by educating the public. On curriculum response to climate change, it was observed that majority of the respondents were of the view that social studies curriculum to a large extent addresses climate change. Few of the respondents however, believed the curriculum some-how helps to response to climate change. The choice of the word to somehow implies that the curriculum is not fully equipping the learners on the issues of climate change.

Regarding whether the curriculum would better respond to climate change if we use foreign curriculum or books, overwhelming majority of the teachers said they would rather go for local curriculum and books that will depict the real situation of a particular country or area. However, a few of them said they will prefer the foreign ones to the local prepared curriculum and books, they are prepared by renowned scholars who the subject area or content. the question was whether social studies curriculum is positively changing the views of students on climate change, out of the four respondents, three said yes, it is making impact and one respondent said no it does not, looking the situation in we are in. On the challenges social studies education faces in responding to climate change, majority of the respondents were of the view that inadequate TLM for teaching and learning, unavailability of resource persons, social studies curriculum is overloaded and the abstract nature of the causes of climate change., few minority respondents were of the view that inadequate teachers‟ knowledge on climate change and politicization of climate change. The ill-responsiveness of the social studies curriculum to climate change in Ghana confirms the report by Laessoe, et al. (2009) that climate change education is still in its infancy.

Analysis and Evaluation of the Data Gathered For Teachers

Data was gathered through triangulation of questionnaires (to assess the regularity of perception alignment) and interviews (gain access to student‟s articulations). For interview results given in chapter four, **MX1, MX2, MX3, MX4** represent the respondents from the four institutions. The results from the interviews were analysed into three themes: understanding of climate change and climate change causation; how climate change is addressed social studies curriculum and challenges in responding to climate change. These themes are in line with the research questions.

Teachers Understanding Climate Change

In a number of different ways, participants were asked for their understanding of climate change; weather they appreciate it as a reality or as non-existent. All of the respondents seemed to take the ontology of climate change as a given, and all busied themselves with giving different aspects which they thought best conceptualizes what climate change is.. Most respondents also seemed to hold perceptions that „Ghana was already feeling the effects of climate change. These were described as „deadly …catastrophic…and disastrous‟. To others climate change brings with it „„…lot of negative effects like ill health, slowdown our economy… makes people to be poor and [brings] loss of lives…; it affects [our] land,… it brings a lot of suffering, and it affects [our] financial state; [has] brought miseries to the poor people…‟ All these sentiments reveal a certain amount of negativity towards climate change; hence a climate change aversion metanarrative. This came through vehemently in the diction the respondents used in their descriptions of climate change. In most cases, climate change is seen as either „„…a problem or as causing problems…; …as a bad thing…with a lot of negative effects…‟ to people and the environment.

However, as to what climate change is precisely, some respondents understanding climate change as a „bad thing" while others understood it as „causing bad things. For one respondent; „definitely something is wrong and that something is climate change." Others substantiated their concepts of climate change by think climate change:

> *…..I think is weather changing, seasons not regular,….changes in weather conditions due to excess gases in the earth's atmosphere due to human activities,……atmosphere changes due to influences from human and natural activities…..global phenomenon associated with global temperature rise owning to man's activities on earth.(four schools interview transcript 2020)*

Most of the respondents seemed to associate climate change with change in seasons, having seasonal overlap. (…raining season looks likes dry season…). The other element which seems to be associated with climate change is flooding. It seems that the respondents are more conscious to the immediate weather disasters locally. All the respondents attributed climate change to anthropogenic theory.

Climate Change Causation

The respondents also came up with an array of climate change causes. Their perceptions were resoundingly the same.

In response to what causes climate change, all respondents seemed to accept that climate is either a caused cause or a caused problem. In either way the reality of climate change causation was not disputed. To most respondents;

> *….Human activities like industries and land use are the cause of climate change; … as result of human activities; human activities from the time of industries revolution have seen to be the cause of climate change… Human activities such as industries and cutting trees are the causes of climate change; … people's activities; A lot of companies like Cement producer are sending a lot of C02 in atmosphere…' (Four schools Interview Transcript 2020).*

n as much as there was no real attempt in detailing the causal links, most respondents had perceptions that climate change has an anthropogenic causation: human industrial activities were singled out as major causes.

The social studies curriculum is it helping in addressing climate change

On curriculum response to climate change, it was observed that majority of the respondents were of the view that social studies curriculum to a large extent addresses climate change. Few of the respondents however, believed the curriculum some-how helps to response to climate change.

> *…… Yes, it helps in addressing climate change…. It somehow attempts to address aspect of climate change but not in full……. No, it does not help in addressing climate change issues.(four schools Interview Transcript 2020)*

Discussion of interviews of students from the four institutions

All respondents from the four institution fall within the age bracket of (16-18 years) old. However, two thirds (2/3) of the respondents from the four institutions asserted they had heard of climate change prior to this interview. Six respondents out of the eight respondents were able to provide meaning of climate change. Some of the responses they are as follows; climate change is defined as changes in weather pattern in the earth, Climate change is weather, Climate change is when weather conditions in a place change only two respondents were unable to advance any meaning or definition to climate change.

Respondents were asked who/ what can be attributed to climate change. Majority of the respondents which is seven out the eight respondents were able to advance some answers to the question which include; nature and human activity. Respondents were asked to state some attributed associated with human activities which include;

farming, mining, cutting down trees, building cities burning of fossil fuel. One person who said no idea to question asked.

Most respondents also claimed to have enough information on climate change to make opinion. Majority 75% of them claimed that they got their information on climate change from trusted sources such; Television, Radio, books, articles internet etc.

Respondents participating in the survey were asked to mention some of the impacts of climate change, majority of them representing seven out of eight were able to give the responses include, the sun is too hot and crops are dying, flooding health risk, increased in temperature, drought etc. Five out of eight were also able to advance some responses to the measures adapted humans to tackled climate change, they answer such; stop building power plant that emit CO2, stop illegal mining, stop pollution and stop deforestation.

On the aspect of causes of climate change, respondents were asked What do you think are the causes of climate change. In a response to this question three respondents out of the eight 65% said climate change is cause by both natural and artificial means. Four out of the eight respondents said climate change is cause by only human activities. One respondent indicated that “I don‟t know” that means he does know whether is cause by nature or man-made. In addition, respondents were asked to Mention examples of natural and anthropogenic causes of climate change. Seven respondents out of the eight gave human activities such farming, burning of fuel, cutting of vegetation, illegal mining, pollution. On the other hand, three out of the eight respondents were able mention both natural and human activities. The natural cloud formation, ocean current and solar variability. The human activities are farming,

burning of fuel, cutting of vegetation, illegal mining, and pollution. One respondent who was not sure said dumping of rubbish in the school gutters, which represents minority view.

Majority 90% of the respondents which presented seven out of eight respondents Mention some activities that humans do leading to climate change as bad farming practices, deforestation illegal mining, pollution of the environment. One respondent said burning of rubbish in the school. Some of the mitigation and adaption measures to climate change mention by respondents are; planting of trees, avoid illegal mining, enforcement of environmental law and also educating the citizens.

The last part of the interview was on the question do you think climate change is something that is affecting or going to affect you? Majority of the participants asserted the fact that climate change is affecting them, some of the responses are; A lot because people are dying every, there are so many diseases in the world. Yes, because there is shortage of food, high temperatures, hunger and diseases everywhere people are dying. Drought happing everywhere, flooding, drought, deforestation and farming is not yielding good.

Analysis and Evaluation of the Data Gathered For Students

Data was gathered through triangulation of questionnaires (to assess the regularity of perception alignment) and interviews (gain access to student‟s articulations). For interview results given in chapter four, **YZX1, YZX2, YZX3,YZX4,YZX5,YZX6, YZX7, YZX8** represent the respondents (Students) from the four institutions.

Understanding about the meaning of climate change

All of the respondents from the four institutions asserted they had heard of climate change prior to this interview. Six respondents out of the eight respondents were able to provide meaning of climate change. Some of the responses they are as follows;

……. climate change is defined as changes in weather pattern in the earth,….. Climate change is weather, Climate change is when weather conditions in a place change…..changes in rainfall. …Yes, I heard of climate change in our class our teacher taught us. He said climate change is the alteration of the weather and atmosphere. *(Four schools Interview Transcript 2020).*

Respondents were asked who/ what can be attributed to climate change. Majority of them said;

Results on Students' Perception Regarding Causes of Climate Change

On the aspect of causes of climate change, respondents were asked what you think are the causes of climate change. In a response to these question three respondents out of the eight said climate change is cause;

…. by both natural and artificial means….it is cause by bush fire…..agriculture and farming. Four out of the eight respondents said climate change is cause by only human activities. One respondent indicated that "I don"t know

> *…Peoples activities on the earth surface…Anthropogenic causes are farming, mining,….. I don't know but let me try students dumping rubbish in the school gutters …. Human activities Anthropogenic causes are cutting down trees… burning of bush (four schools Interview Transcript 2020).*

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the study, key findings, conclusions and recommendations for policy making and professional practice. A suggestion for further research has also been provided in this chapter.

5.2 Summary of Findings

Climate change has become a contemporary global problem which the world is battling with. It is destroying properties and lives, worsening poverty and annulling developmental gains. It has become necessary and justified on the need for proactive mitigation and adaptation responses. One important necessity in the adaptation and mitigation process is by ensuring that the very people who supposedly cause it, and are affected, understand and appreciate the nature of the problem. The study set out to assessing senior high school social studies teachers and students perceived challenges and response to climate change in the Bolgatanga municipality. Specific objectives were to; examine how social studies teachers and students perceived climate change; explore means in which social studies curriculum responds to climate change; examine what social studies teachers and students‟ perceived as challenges to responding to climate change. These objectives were curved out after a rigorous review of concepts and theories to give the research a clear focus. To achieve the objectives set in the research, a sample of 41 teachers and 122 students was selected from a student population of 10503 from. Proportional sampling, stratified and simple random samplings were used to constitute the sample size. Due to issues of student absenteeism and difficulty in tracing the selected students coupled with the time frame allotted for the data collection process, the resultant sample size was 122 which were

lesser than the theoretical/predetermined sample size of 380. A mixed method approach was chosen for the study. Data were collected from the social studies teachers and students through the use of questionnaires and interviews. Data were analysed and presented by the use of percentages, frequencies to examine the relationships of the variables in the study. The main findings of the study

5.2.1 The level of understanding of Social Studies teachers and students about Climate Change

Generally, the results from the study suggests that the Social Studies teachers have, to a large extent, irreplaceable knowledge about the meaning of climate change. However, majority (83.8%) of the respondents (teachers) disagree to the statement, "anything about the weather is climate change. Essentially, about 34 (91.9%) of the teachers agreed that Climate change is the alteration of the world"s climate. Additionally, 33 (89.2%) of the teachers believe that climate change is the change that can be attributed directly or indirectly to human activity that alters the composition of the global atmosphere. It is important to state that majority (70.3%) of the teachers also agreed that climate change is a political issue or ideology. The other definitions that majority of the teachers agreed on were the following; that Global warming is a sign of climate change, Melting of ice is an indication of climate change, Desertification is partly the result of climate change, Change in the pattern of rainfall is climate change, Climate change is natural, Climate change is a worldwide phenomenon, Rise in sea level is the result of climate change.

With regards to the students" responses, the results were contrarily to the teachers" responses. Majority of the students were uncertain with most of the various definitions of climate change.

5.2.2 How social studies curriculum responds to climate change

Majority (48.6%) of the teachers believed that the Social Studies curriculum addresses climatic issues to a large extent. Few (18.9%) were uncertain as to whether the curriculum addresses climatic change. However, out of the 37 teachers, 12 (32.4%) believe the curriculum some-how helps to response to climate change. Moreover, some (35.1%) of the teachers believe that Social Studies curriculum would better respond to climate change if it is designed by teachers themselves. This assertion made was opposed by 14 (37.8%) of the teachers. Regarding whether the curriculum would better respond to climate change if we use foreign Social Studies curriculum or books, an overwhelming majority (73.0%) of teachers said not at all. Essentially, 28 (75.7%) of the teachers agreed to a large extent that the Social Studies curriculum should be redesigned to better handle issues of climate change.

5.2.3 Teachers' perception about the challenges social studies education faces in responding to climate change

Most of the teachers agreed to all, the following challenges ; Inadequate TLMs for teaching climate change, Unavailable of resource persons, Social Studies curriculum is overloaded with other issues, Abstract nature of the causes of climate change, Difficulty in communicating climate change issues to the students, Centralization of the curriculum, Inadequate curriculum designers‟ knowledge on climate change, Inadequate teacher‟s knowledge on climate change, Politicization of the debate on climate change, Financial constraint, Poverty and finally Because the effect of climate change has not been sufficiently yet. However, some (2.7% to 13.5%) of the teachers disagreed to the challenges.

5.3 Conclusions

From all that have been presented in the findings above we can conclude that, social studies teachers have a large extent an irreplaceable knowledge about climate change, majority of them which constitute (86%) agree to all the statement about climate change. Therefore, if aspect of climate change themes, content and issues are introduced at full length in the S.H.S social studies curriculum teachers would not have much challenge in teaching them. However, on the part of the students it was revealed that student have low knowledge on the meaning of climate change, as high as 58.6% were uncertain or don‟t know. The research can conclude that most of the students have heard of climate change but they seem confused about the meaning of climate change. Their understanding of the science of climate change is far below expectations as compared to internationally accepted definitions such that given by the IPCC. This is because while they are sure that human beings are the major cause of climate change, they don‟t seem to get it clear how human beings cause it.

On the curriculum response to climate change (75.6%) of the teachers believed that the current curriculum addresses climate change issues in it. However, it was surprise from the findings that 12% of them were uncertain, which is a worrying situation in the fight against the menace. From the findings it was discovered that social studies curriculum is incomplete when it comes empowering and equipping leaners with relevant knowledge on the issues of climate change, therefore, the inferences is that social studies curriculum may demand a redesign to achieved its purposed.

From the findings of the study on challenges that teachers and students face in responding the climate change (94%) of them agree to all the challenges listed. These therefore indicate that there are many obstacles preventing the current curriculum from responding to climate change issues. Thus, total incorporation of climate change

concepts in the curriculum will definitely confronts with similar challenges as it currently exist.

5.4 Recommendations

Based on the main findings of the study and the conclusions drawn, the following recommendations were made for policy makers and further research.

1. Ministry of Education through the Ghana Education Service (GES) in collaboration with all the Universities and Headmasters various SHS should fashion out teacher development programmes such as workshops, conferences, seminars, regular in-service training and short courses for teachers. In these programmes, the organisers must ensure that teachers have access to high quality content course work and knowledge on climate change issues to cope with menaces climate change.
2. Teachers and students should also make personal efforts to look for information on climate change and pass same to others. They should also ensure that they change their attitude and behaviour towards causes, impact and mitigation and adaptation of climate change through their systems of extra-curricular activities.
3. The rich knowledge of the teachers should be tapped when introducing climate change issues or redesigning the Social Studies curriculum.
4. National Council for Curriculum Assessment and GES should include more topics relating to climate change in the curriculum.
5. Ministry of Education through the Ghana Education Service (GES) and NGOs into climate change matters develop and circulate learning materials on climate change to all schools in Ghana. The ministry should strive to provde

books magazines and charts that illustrate climate change in a simple and easy to understand for teachers and students for the purpose of learning.

6. Ministry of Education through the Ghana Education Service (GES), School authorities NGOs, FBOs and CBOs dealing with climate change to take up bigger roles in encouraging and motivating students to form clubs and association‟s who in tree planting exercises and provision of seedlings for them to plant as a project to green the country.

5.5 Limitation of the Study

A retrospective view with research for this thesis indicate that, while it represents a significant and original contribution to the field, it also suffers from inevitable limitation and weakness among them include the outbreak of the COVID 19 in the country which the authorities close down schools.

The study did not cover the whole municipality schools but only Social studies teachers and students and some few Senior High Schools. I therefore do not intend to generalize my findings.

A major limitation of the study was the inability to assess social studies teachers and student‟s perception on climate change in Bolgatanga municipal which are comparable in status to the selected schools. Secondly, the nature of the closed-ended questionnaire might have made it possible for the Social Studies teachers to respond to the items without understanding or even reading them (because they were to respond to the closed-ended items by just ticking).

NOTE: The transcriptions of the interview were often difficult to do accurately as voices and nuances can be lost in recordings devices. Therefore, the researcher recognizes that not capture 100% of the recorded words of the respondents.

5.6 Suggestions for Further Research

The level of understanding and dispositions of policy makers and top government officials further research should try to address the need for a more theory grounded approach to understanding perceptions of, and behavioural response to, climate change.

Further research should be carried out to determine factors influencing teachers‟ level of awareness on climate change.

Further research should be conducted on curriculum and climate change to ensure that curriculum is exploited to create climate change awareness among learners in the early stages.

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APPENDIX B

Questionnaire for Teachers

I am Nyaaba Francis Kapuseba., a student of University of Education Winneba undertaking a Master Philosophy Degree in Social Studies (Climate Change and Sustainability). I am carrying out a research on assessing social studies teachers and students perceive challenges in climate change in senior High schools in Bolgatanga Municipal. It is my humble request that you kindly fill this questionnaire as honestly and accurately as possible. You do not have to answer these questions if you don‟t want to. You can also stop answering at any time. If you decide to stop, no one will be angry or upset with you. The information you give will only be used for this research and will be treated with utmost confidentiality. Kindly DO NOT write your name anywhere in this questionnaire.

Demographic information

1. Kindly indicate your gender.

a. Male [ ]

b. Female [ ]

2. Indicate your highest academic qualification

a. Diploma [ ]

b. Degree [ ]

c. Post-graduate diploma [ ]

d. Masters [ ]

e. PhD [ ]

3. Tick (√) the bracket indicating the number of years you have taught in secondary school.

a. 1-5 years [ ]

b. 6-10 years [ ]

c. 11-15 years [ ]

d. 16-20 years [ ]

e. More than 20 years [ ]

4. Indicate your subject(s) of specialization……

SECTION -A UNDERTSANDING ABOUT GLOBAL CLIMATE CHANGE

5. Have you ever heard of climate change?

Yes [ ]

No [ ]

Don‟t Remember [ ]

6. How do you understand climate change?

……

……

……

7. Who/ what can climate change be attribute?

……

……

……

8. How do (does) the person(s) / object(s) in stated in above contribute to climate change

SECTION- B PERCETIONS OF CLIMATE CHANGE

9. Do you personally think or feel there has been a change in climate

Yes [ ]

No [ ]

10. Please give reason to your response in above

……

……

……

In each of the following statements, indicate your understanding of climate change by ticking (√)			
Statement	Uncertain	Disagree	Agree
(11) Climate change is the alteration of the world‟s climate			
(12) Global warming is a sign of climate change			
(13) Melting of ice is an indication of climate change			
(14)Desertification is partly the result of climate change			
(15) Change in the pattern of rainfall is climate change			
(16) Climate change is driven by human activities			
(17) Climate change is natural			
(18) Climate change is a political issue			
(19) Climate change is a worldwide phenomenon			
(20) Rise in sea level is the result of climate change			
(21) Anything about the weather is climate change			

SECTION-CCAUSES OF CLIMATE CHANGE

In each of the following statement determine the causes of climate change (on the right-hand side) and the degree of cause (on the left-hand side) by ticking (√)						
THE DEGREE OF CAUSE			STATEMENT	CAUSE		
Highest	Higher	High	Climate change is cause by:	uncertain	Disagree	Agree
			(1) Excess C02 in the atmosphere			
			(22) Chlorofluorocarbons			
			(23) Depletion of the ozone layer			
			(24) the burning of fossil fuel			
			(25) Variation in the sun‟s energy			
			(26) Ocean circulation (current)			
			(27) Cutting –down of trees and bush burning			

			(28) Building of cities			
			(29) Irrigation of desert			
			(30) Volcanic eruption			

SECTION-D SOCIAL STUDIES CURRICULUM RESPONSE TO CLIMATE CHANGE

Indicate your view on Social Studies curriculum"s response to climate change by ticking (√)				
Statement	Not At All	Not Sure	Some-how	To a Large Extent
(31) the Social Studies curriculum is addressing climate change				
(32) The Social Studies curriculum is helping teachers to handle climate issues sufficiently				
(33) The Social Studies curriculum is increasing people"s knowledge on climate change				
(34) The Social Studies curriculum is positively changing students views about climate change				
(35) The Social Studies curriculum should be redesigned to better handle issues of climate change				
(36) The Social Studies curriculum would better respond to climate change if it is designed by teachers themselves				
(37) The Social Studies curriculum would better respond to climate change if we use foreign Social Studies curriculum or books				

38. As a Social Studies teacher are you aware of climate change education?

A. Yes [ ]

B. No [ ]

39 How many minutes do you have for teaching Social Studies per week per class?

A.120 minutes [ ]

B. 160 minutes [ ]

C. 200 minutes [ ]

D. 240 minutes [ ]

E. 280 minutes [ ]

40. State topics in the Social Studies syllabus that addresses climate change

……

……

41. What ideal features should a curriculum (syllabus) that addresses climate change possess? (Name two)

……

……

SECTION-E

CHALLENGES THAT SOCIAL STUDIES EDUCATION FACE IN RESPONDING TO CLIMATE CHANGE

For each of the following statement determine challenges that Social Studies education face in responding to climate change						
DEGREE OF CHALLENGE OR NO CHALLENGE			STATEMENT	CHALLENGE		
Greatest	Greater	Great		uncertain	no	yes
			(42) Inadequate TLMs for teaching climate change			
			(43) Unavailable of resource persons.			
			(44) Social Studies curriculum is overloaded with other issues			
			(45) Abstract nature of the causes of climate change			
			(46) Difficulty in communicating climate change issues to the students			
			(47) Centralization of the			

			curriculum			
			(48) Inadequate curriculum designers knowledge on climate change			
			(49) Inadequate teacher‟s knowledge on climate change			
			(50) Politicization of the debate on climate change.			
			(51) Because the effect of climate change has not been sufficiently yet.			
			(52) Financial constraint			
			(53) Poverty			

APPENDIX C

Questionnaire for Students

I am Nyaaba Francis Kapuseba, a student of University of Education Winneba undertaking a Master Philosophy Degree in Social Studies (Climate Change). I am carrying out a research on assessing social studies teachers and students perceive challenges in climate change in Senior High Schools in Bolgatanga Municipal. It is my humble request that you kindly fill this questionnaire as honestly and accurately as possible. You do not have to answer these questions if you don"t want to. You can also stop answering at any time. If you decide to stop, no one will be angry or upset with you. The information you give will only be used for this research and will be treated with utmost confidentiality. Kindly **DO NOT** write your name anywhere in this questionnaire.

Section A: DEMOGRAPHIC INFORMATION

1. Please indicate your gender.
   a) Male [ ]
   b) Female [ ]
2. Please indicate the age bracket applicable to you.
   a) Below 14 years [ ]
   b) 14- 16 years [ ]
   c) 16- 18 years [ ]
   d) Above 18 years [ ]
3. Indicate the name of your school…….
4. What type of school do you attend?
   a. Boys only [ ]
   b. Girls only [ ]
   c. Mixed (boys & girls) [ ]

5. Please pick the optional subject you do from the list below.

a. Agriculture [ ]
b. Biology [ ]
c. Business studies [ ]
d. C.R.S [ ]
e. Chemistry [ ]
f. Geography [ ]
g. History and Government [ ]
h. Physics [ ]

SECTION B: Understanding and knowledge about global climate change

6. Have you ever heard of climate change?

Yes [ ]
No [ ]
Don't remember [ ]

7. If you possess any knowledge on climate change, tick below the source of such knowledge.

a. JHS/SHS Education [ ]
b. Media [ ]
c. The internet [ ]
d. Family/friends [ ]
e. Personal readings [ ]

In each of the following statements, indicate your understanding of climate change by ticking (√)			
Statement	**Uncertain**	**Disagree**	**Agree**
(8) Climate change is the alteration of the world"s climate			
(9) Global warming is a sign of climate change			
(10) Melting of ice is an indication of climate change			
(11) Desertification is partly the result of climate change			
(12) Change in the pattern of rainfall is climate change			
(13) Climate change is driven by human activities			
(14) Climate change is natural			
(15) Climate change is a political issue			
(16) Climate change is a worldwide phenomenon			
(17) Rise in sea level is the result of climate change			
(18) Anything about the weather is climate change			

APPENDIX D

Interview Guide for Teachers

This interview focuses on assessing senior high school social studies teachers‟ and students‟ perceived challenges and response to climate change in the Bolgatanga Municipality.

1 Please tell me something

2 About yourself (age, academic level, number of years taught, subject specialization etc)

3 Have you heard of climate change? Explain what you know about it

4 Where do you get your information about climate change? Which sources of information do you trust

5 Who/what can climate change be attributed to? In the past two years have you felt or experience climate change personally? Do you think Ghana has been affected yet?

6 What do you think, are there negative effects of climate change on the society and the environment?

7 Can you imagine which group are most affected by climate changes?

7. What do you think causes climate change? Can you give examples of the causes of climate changes?

8. Can you tell me some human activities that help climate change to occur

9. Do you think there is anything as human beings we can do about it? What do you think your country and you are about it?

10. Are you aware of any organizations, that are doing anything with regards to climate change?

11. The social studies curriculum is it helping in addressing climate change issues? Is the curriculum helping teachers to handle climatic issues sufficiently?
12. The social studies curriculum is positively changing students view about climate change?
13. Would prefer foreign social studies curriculum and books or your own prepared one and why? State the topics in the social studies syllabus that addresses climate change
14. What are the challenges that social studies education faces in responding to climate change

APPENDIX E

Interview Guide for Students

This interview focuses on assessing senior high school social studies teachers‟ and students‟ perceived challenges and response to climate change in the Bolgatanga Municipality.

1 Please tell me something about yourself (age, form, optional subjects etc.)

2 Have you heard of climate change? What does climate change mean to you(explain)

3 What/ who can climate change be attributed to? State at least two attributes of climate change

4 Where do get your information about climate change? Do you have enough information on climate change to form an opinion

5 What impact(s) do you think climate change has/have? What are (is) the way tackling climate change?

6 What do you think are the causes of climate change? Mention examples of natural and anthropogenic causes of climate change?

7 Mention some activities that humans do leading to climate change?

8 Mention some of the mitigation and adaption measures to climate change?

9 Do you think climate change is something that is affecting or going to affect you?

APPENDIX F

TOPICS IN THE CURRENT SOCIAL STUDIES SYLLABUS (2010)

SHS1	SHS2	SHS3
SECTION 1: ENVIRONMENT (Pg.1-7) Unit 1:Self-identity Unit 2:Adolescent Reproductive Health Unit 3: Our Culture and National Identity	**SECTION 1: ENVIRONMENT (Pg.18-25)**Unit1:The Institution of Marriage Unit 2: Individual obligation in the Family Unit 3:Responsible parenting Unit 4: socialization and our Social Environment	**SECTION 1: ENVIRONMENT (Pg36-38.)** Unit 1: Our Physical Environment and Environmental Challenges Unit 2: Education and Societal Change
SECTION 2: GOVERNANCE, POLITICS AND STABILITY (Pg. 8- 12) Unit 1: National Independence and Self-reliance Unit 2: Peace Building and Conflict Resolution	**SECTION 2: GOVERNANCE, POLITICS AND STABILITY (Pg. 26-29)** Unit 1: Leadership and Followership Unit 2: Our Constitution, Democracy and Nation Building	**SECTION 2: GOVERNANCE, POLITICS AND STABILITY (Pg. 39- 42)** Unit 1: Rights and Responsibilities of the Individual Unit 2: Ghana and the International Community
SECTION 3: SOCIOECONOMIC DEVELOPMENT (Pg. 13-17) Unit 1: The Youth and National Development Unit 2: Science and Technology Unit 3: Resource Development and Utilization in Ghana	**SECTION 3: SOCIOECONOMIC DEVELOPMENT (Pg. 30-35)** Unit 1: The Role of the individual in Community Development Unit 2: Promoting National Socio-Economic Development Unit 3: Sustainable Development	**SECTION 3: SOCIOECONOMIC DEVELOPMENT (Pg. 43-46)** Unit 1: Population Growth and Development Unit 2: The world of Work and Entrepreneurship

Source: Ghana Education Service (2010)