

Climate Change Education in Basic Schools: The Educators' Lens on Techniques and Challenges

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ABSTRACT

Our natural environment is seriously deteriorating which requires continual climate change education. The teacher acts as the conveyor belt in maximizing learners' knowledge of our natural environment and its repercussions. The study inquired about climate change education in basic school: the role of Social Studies teachers. A mixed-method research design was utilized. A convenience sampling technique was employed for 30 public school Social Studies teachers. Data were collected using instructional methods of teaching climate change questionnaires and nine semi-structured interviews. Data were analyzed using descriptive statistics and interpretation. The findings of the study uncovered that the dominant instructional methods employed by Social Studies encompass discussion, field trips, and brainstorming. The challenges that obturate the teaching of climate change include inadequate funds to embark on field trips, inadequate teaching and learning resources, inadequate teachers' content knowledge, and inadequate time. The study recommended that teachers should practice a learner-centered method of teaching. Also, adequate teaching aids, in-service training, and funds should be provided to enrich teachers' effective teaching of climate change.

Keywords: climate change, anthropogenic, methods, techniques, strategies, challenges, field trip.

INTRODUCTION

Climate change, an alteration in global or regional climate patterns, has a long historical background that has been explained for many years by several groups of people such as climatologists. It means a long-term change in earth's climate as measured by quantifiable changes in temperature, wind speeds, precipitation, and sea level (Intergovernmental Panel on Climate Change [IPCC], (2014). Scientists such as Dawson and Carson (2013), and Fraser (2019) posit in agreement those anthropogenic activities such as the combustion of fuel, illegal mining, sand winning, and environmental pollution are liable for climate change; many people are still pessimists or skeptical of climate change in our natural environment. There is increasing scientific validation proving that observed average temperature has increased globally since the mid-twentieth century. Climate change has become a global problem when its access and impacts are considered dangerous (Stern, 2008). Also, along with this global temperature rise, there are expansions in glacier lakes and increase in rock avalanches in the mountainous zones such as the Alps; modifications in the Antarctic ecosystems such as changes in the confines of animals and plant species or bird migration (Parry, Canziani, Palutikoff, Van der Linden & Hanson, 2007). The major concerns indicated include soil erosion, storms, desertification, coastal erosions, flood and degradation of agricultural land, mass migration, diseases (i.e.

cholera, malaria), increase in sea level, and heat stress (Parry, Canziani, Palutikoff, Van der Linden, & Hanson, 2007; Stern, 2008). Pro-environmental activities such as afforestation, ecological farming, and forest conservation manipulate the world's climate through chemical, biological, and physical processes that incorporate carbon dioxide, water, exchanges of energy, and other chemical variants within the atmosphere (Bonan, 2008). Other proof exhibits that pro-environmental programs such as afforestation and ecological farming conserve the high rates of evapotranspiration in plants (Bonan, 2008); and serve as natural carbon sinks (Denman, Brasseur, Chidthaisong, Ciais, Cox, Dickinson, & Zhang, 2007), because absence of forests cover leads to exceptional heating in our environment (Feddema, Oleson, Bonan, Mearns, Buja, Meehl, & Washington, 2005). Hence, it can be deduced that pro-environmental programs induce the world's climate. With the accelerating call for food and energy, the necessity for global croplands and plantations has expanded. The alteration of forest cover for agriculture utilization has resulted in the wastage of biodiversity (Foley, 2005). Limiting the greenhouse effect and confirming the consequences of climate change is significant to deal with the question within our natural environment. All and sundry suffering from the effects of climate change try to find a practical solution and are more likely to contribute and rally behind governmental policies (Hulme, 2016). Governments are certainly wary that climate change is vague. Extreme weather events such as floods, heavy storms, and soil erosion already trouble a lot of people, and a large majority will be put out very shortly (IPCC, 2014). Due to the unclear consequences of climate change, world leaders have undertaken ambitious steps and have adopted some global governmental policies (targets set by the Paris Agreement, 2016) to wrestle with the effects of climate change. The 2015 Paris Agreement calls for vital areas to face up to climate change and defines these areas as future temperature goals, global peaking, mitigation, sink and reservoirs, voluntary cooperation, adaptation, loss and damage, finance, technology and capacity building support, transparency, global stock take and *climate change education, training, public awareness, public participation, and public access to information* (United Nations Framework Convention on Climate Change [UNFCCC], 2019). Persistent climate change education is primarily engrossed on one key stakeholder- the teacher (Favier, Van Gorp, Cyvin, & Cyvin, 2021). Teachers serve as the core of the educational ecosystem and are obligated to assist learners in understanding the consequences of climate change in this unpredictable period. The prime goal of this inquiry is to clear up the last key features of the Paris Agreement, which are climate change education, training, and increasing public awareness. The role of education is paramount for honoring and battering the dangers of climate change. Several studies have highlighted the relevance of climate change education (Seow & Ho, 2016; Higde, Oztekin, & Sahin, 2017; Karpudewan & Khan, 2017). The adaptation and mitigation strategies for wrangling the effects of climate change are usually skipped over in education (Bangay & Blum, 2010). Furthermore, alternative educative avenues engrossing nature, the environment as well as forest cover are advocated to raise environmentally sentient learners (Sokut, Inalpulat, Ayman, Genc, Arslan, & Bobek Bagan, 2018). With all the teaching methodologies, outdoor education (field trips, fieldwork, place-based, or experiential learning) is considered appropriate. (Wilhelmsson, Lidestav, & Ottander, 2012; Fagerstam, 2014; Cil, Maccario, & Yanmaz, 2016). This approach is dissociated from the classroom setting and encompasses heterogeneous contexts where learning occurs such as museums, science resource centers, or botanical gardens (Walsh & Straits, 2014). Outdoor education links learners to have an affiliation with their natural environment through familiarization with the environment. Several studies inquired about the short-term effectiveness of outdoor learning programs (Ozdilek, & Yalcin-Ozdilek, 2015; Okur-Berberoglu, Ozdilek, & Yalcin-Ozdilek, 2015; Cil, Maccario, & Yanmaz, 2016). For instance, Okur-Berberoglu, Ozdilek, & Yalcin-Ozdilek, (2015), inquired about in-service teachers' environmental awareness after participating in a short-term outdoor environmental program and indicated that short-term programs were effective in terms of maximizing teachers' environmental consciousness and sensitivity to the natural environment.

Fagerstam (2014), inquired with the teachers who applied for school-based outdoor teaching and learning programs and revealed that teachers believe that outdoor teaching programs activate learners' desire in their natural environment as well as enhance communication and collaboration among learners. Other research

conducted with Swedish teachers who implemented outdoor learning, underlined that outdoor activities enhance learners' participation in fieldwork (Wilhelmsson, Lidestav, & Ottander, 2012). Several researchers emphasized that outdoor learning-focused programs enhanced collaborative learning, creative thinking skills, and active participation among learners (Wilhelmsson, Lidestav, & Ottander, 2012; Fagerstam, 2014; Cil Maccario, & Yanmaz, 2016). Other studies uncovered that some challenges and issues align with outdoor learning (Dyment, 2005; Black, 2013). Dyment (2005), posits that several teachers lacked the ability and eagerness to conduct outdoor learning programs. Moreover, Black (2013), emphasized the relevance of careful planning, and mobilization of resources for outdoor learning programs. Due to the present phenomenon of climate change, it is explicit that citizens should be wary of the planet's vital signs and be conscious of the necessity for expediting pro-environmental programs, encompassing taking persistent strides to alter conservation efforts and future planning. To avert the dangerous dents of climate change, there is an imperative need for the intensification of climate change education in Ghanaian basic schools in which basic schools in Assin Fosu Municipality are not exempted. Understanding the processes and interpretations of climate change is difficult for learners as they remain very open to the effects of the changing climate. Teachers must be well informed on climate change to have in-depth knowledge that will resonate with learners (Seigner & Stapert, 2020). Educators and policymakers also have a decisive responsibility to play in subliming learners' and societies' consciousness of and knowledge about climate change. Previous studies revealed that climate change is one of the least known environmental challenges and that people hold certain sentiments that are not in line with common scientific notions irrespective of age or nationality (Sellmann, Lieflander, & Bogner, 2015). This is the justification motive to increase climate change education in basic schools in Assin Fosu Municipality.

Purpose of the Study

The purpose of the study was to assess the experiences of Social Studies teachers in teaching climate change. Specifically, the study looked at the teaching techniques Social Studies teachers employ in teaching climate change and the challenges they encounter in the teaching of climate change.

LITERATURE REVIEW

Theoretical Framework

The theoretical base for the study was the human forcing besides the greenhouse theory of climate change and the anthropogenic global warming theory of climate change.

Human Forcing Besides Greenhouse Gases Theory of Climate Change

The continuous deterioration of our natural environment is one of the influences of climate change. Previously, the earth's climate was very favorable for living organisms but the invention of industrialization and technology has altered the earth's climate distinctions. This theory of climate change covers relevant human-induced activities that increase climate change in our natural environment. Deforestation is one major attribute of human forcing besides greenhouse gases. The forests covered within our natural environment play a pivotal role in the Earth's climate system, in various manners. The forest cover apprehends carbon dioxide from the Earth's atmosphere and modifies it, through the process of plant preparation of their food (photosynthesis), into a living biomass (FAO, 2010). The forest cover serves as an air cleaner (air filter) for carbon dioxide drinking in the atmosphere. Forest cover regulates the air and Earth's surface temperatures by soaking up carbon dioxide content. A wane in the forest cover on the Earth's surface would eventually lead to a weighty increase in temperature (Yuksel, 2014). Forest cover enhances evapotranspiration which results in a cooler temperature within a particular area. When forest cover is burnt or cleared, it increases the carbon dioxide content in the atmosphere. This leads to catastrophic rainfall spells in the environment. Also, the continuous burning of fossil fuels throughout the

world has been on the rise. The agricultural food sector overuse 30% of global energy demand, which is largely intersected by fossil fuel sources, and discharges around 22% of total anthropogenic greenhouse gases (FAO, 2011). The NRC (2011) asserts that the Earth's surface is getting hotter because humans are piling up heat-trapping gases like carbon dioxide, nitroxides, and water vapor in the atmosphere, usually by burning fuels such as petrol, kerosene, and diesel. As fuel utilization increases, the coverage of gases such as water vapor, and carbon dioxide in the atmosphere spikes. Combustion of fossil fuels such as natural gas, and oil, increases the level of carbon dioxide which limits the carbon dioxide taken up by trees. This theory of climate change underlines human-induced activities that dilapidate our natural environment. Several of these human forces besides greenhouse activities have a huge influence on local and regional climate change. Again, urbanization has led to the expansion of towns and cities due to an increase in population. However, unplanned urbanization within our natural environment affects the economy, and deforestation as well as environmental degradation transfuse gradually to climate change, and global warming (Zhang & Chen, 2017). The concrete and asphalt of urban environments reduce the city's reverberation as compared to the natural environment. This increases the coverage of solar radiation resorbed at the Earth's surface. There is a small quantity of trees in the cities as compared to the rural surroundings and hence the cooling consequence of evapotranspiration and shade are shortened. The cooling phenomenon of winds can also be lessened by the populated urban settlements. As cities grow, there is a lot of heat in the environs which results in warming in the environment. More, broadscale changes in land use patterns, and land use intensification have promoted desertification and land degradation (IPCC, 2020). The utilization of land for farming, schools, and cities has relevantly altered the roughness and reflectivity of the Earth's surface solar radiation and has enhanced absorbed evaporation, radiation, and evapotranspiration. Such modifications in land utilization are liable to changes in climate. This alteration in climate change increases greenhouse effects.

Anthropogenic Global Warming Theory of Climate Change.

Energy from the sun moves through a vacuum and reaches the Earth's surface. The Earth's atmosphere is dominantly clear to the influent sun rays, admitting it to get onto the Earth's surface where some of it is soaked up and reverberated as heat into the atmosphere. Definite gases in the atmosphere, referred to as greenhouse gases surround the preceding solar radiation, which turns the Earth's atmosphere becoming hotter. Water vapor is a prevalent greenhouse gas liable for about 36 to 90% of the greenhouse consequences, followed by carbon dioxide (< 1-26%), methane (4-9%), and Ozone (3-7%). Previously, human activities that encompass bush burning, burning wood, deforestation, and fossil fuels, are guessed to have appreciated the quantity of carbon dioxide content in the atmosphere by a range of 50%. Consecutive activities of deforestation, and burning fossil fuels could maximize the quantity of carbon dioxide content in the atmosphere during the near future. The climate of the planet Earth is responsive to many external influences, such as planetary orbits and solar radiation, but these forces according to Mudge (1997), cannot expound the increase in Earth's temperature over the previous years. The forcing is caused straightforwardly by man-made greenhouse gases which is scanty, but the anthropogenic global warming theory connotes that positive feedback increases the costs of these gases between two- and four-fold. Slight increases in temperature cause more evaporation which increases the acceleration of water vapor in the atmosphere, which gives rise to more warming. Continual global warming brings about a decrease in glacier cover, which will expose the Earth's surface to a lot of solar radiation. The snow and ice- cover absorb more solar radiation which decreases the heat intensity on the Earth's surface. Anthropogenic global warming underlines that, human-induced carbon dioxide is responsible for the erratic rainfall pattern, glacier, and ice-melting, extinction of natural species, poor agricultural output, and excessive warming of the earth.

Teaching Techniques for Climate Change

Herman, Feldman, and Vernaza-Hernandez (2017) inquired about Florida and Puerto Rico secondary

science teachers' methods of teaching climate change. Their study objective included assessing the teaching methods and techniques teachers employed. The outcome of the study showed that both Florida and Puerto Rico science teachers utilize varied methods in teaching climate change. This is in line with Brumam, Ohl, and Schulz's (2022) study on inquiry-based learning (learner-centered method) on climate change in upper secondary education. They showed that climate change is a complex issue that is confronting our current environment. Therefore, teaching climate change requires teachers to offer learners to explore and pose their researchable questions. This points out that, teachers utilize varied teaching methods in teaching climate change. The above findings corroborate with Monroe, Plate, Oxarat, Bowers, and Chaves (2017) who disclosed that climate change education requires teachers to possess a repertoire of skills and knowledge that will salivate learners' interest in climate change lessons. This requires teachers to use pragmatic teaching methods such as field trips, role-play, simulation, and discussion in teaching climate change. Monroe et al are interested in effective climate change teaching and learning strategies. Also, Adlit and Adlit (2022), researched teaching climate change: a systematic review from 2019 to 2021. The objective of the research was to inquire about the multifaceted teaching methods, techniques, and strategies teachers employ in teaching climate change. Their study showed that teaching climate change requires the utilization of active and participatory teaching methods such as role-play, discussion, demonstration, project-based, and field trips. This aligns with Karim, Othman, Zaini, Rosli, Wahab, Kanta, Omar, and Sahani (2022) who posit that teachers need to enhance their knowledge of climate change, utilize learner-centered methods of teaching, and also encourage the development of community projects to curb climate change in our environment. Karim et al objective was to how teachers practiced student-centered teaching and learning approaches to climate change. The above studies were relevant to the current research work because the researchers seek to find out the teaching techniques Social Studies teachers employ in teaching climate change.

Challenges Teachers Encounter in Teaching Climate Change

Lesley-Ann (2010) studied exploring the challenges of climate science literacy. She revealed that many teachers teach climate change in a disjointed manner. This means that teachers' level of sequencing teaching and learning methods, techniques, and strategies in climate change is low. The above findings agree with Wise (2010) who investigated climate change in the classroom: patterns, motivation, and barriers to instruction among Colorado Science teachers. The findings about patterns of climate change instruction showed that teachers are not knowledgeable on concepts of climate change. Also, Kranz, Winter, and Möller (2022), studied climate change education challenges from two different perspectives of climate change: Perceptions of school students and pre-service teachers. They revealed that climate change education can play an essential role in producing environmentally conscious citizens. However, most teachers are glued to the orthodox teaching methods and this inhibits teachers from making the climate change lesson more pragmatic to solve the challenges our environment is confronted with. The finding is significant to the current study because the research seeks to find out the challenges Social Studies teachers encounter in teaching climate change.

Conceptual Framework

Climate change is dwindling the climatic pattern of our natural environment. This change is caused by both anthropogenic and natural factors such as deforestation, urbanization, volcanic eruption, and changes in Earth's orbit. Both activities have led to famine, flooding, desertification, and extreme heat on Earth's surface. This significantly correlates with the construct that climate change is a big challenge that is deteriorating our natural environment which needs to be stalled. Effective and efficient climate change education in schools is one of the most essential and practical ways to increase both teachers' and learners' capacities for mitigating the climate crisis in our society (Mochizuki & Bryan, 2015). Climate change education is a decisive tool targeted at equipping citizens to wrestle with climate change and its consequences ((UNESCO, 2009). Without persistent climate change education in schools, wrestling with the

repercussions of climate change within our natural environment will be a discouraging task. Climate change education is an ecological phenomenon that requires practicing pro-environmental activities that will amend and impact the world's climate. The implicit tenet of climate change education is to aid learners in acquiring adequate knowledge and skills to solve the harmful impacts of climate change on our natural environment. Similarly, climate change education compels teachers to acquire vast knowledge, skills, and attitudes to teach learners how to practically initiate and devise appropriate solutions to the challenges of climate change in our environment. Fahey, Labadie, & Meyers (2014) posit that the pedagogy for climate change education should not be teacher-centered but rather learner-centered. Therefore, climate change education calls for field trips, place-based education, discussion, and free-choice learning. Climate change education encompasses creatively nurturing learners who function as agents of change in sustaining our natural environment.

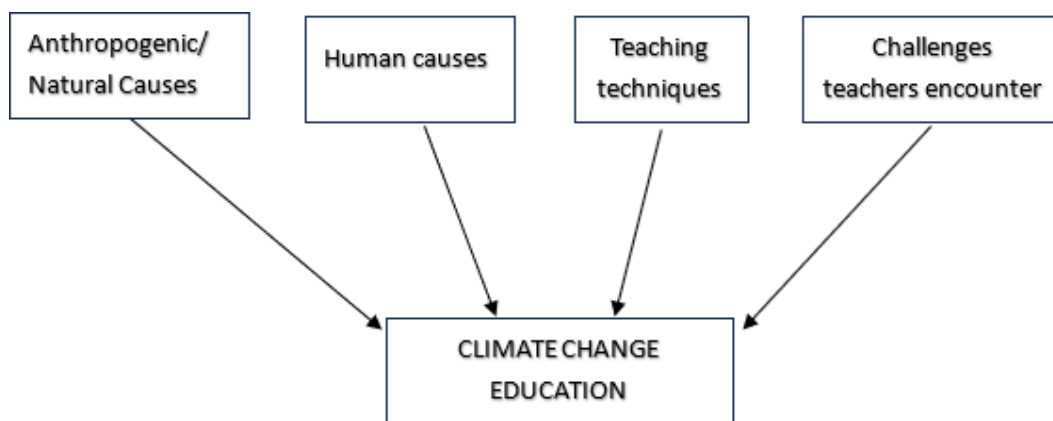


Figure 1: Conceptual framework

Source: Researchers' construct

METHODOLOGY

The study adopted an explanatory sequential research design under the mixed-method approach. This design was used to triangulate the quantitative data with that of the qualitative data, to get a clearer picture and comprehension of the study. In addition, it also allows the readers to get a clearer picture and better comprehension of the findings of this study (Creswell & Clark, 2007). The researchers adopted this design to reduce the weaknesses associated with quantitative and qualitative data. This is because issues that the questionnaire could not prove could be addressed by the interview and vice versa. The sample for the study was 30 public junior high school Social Studies teachers who were sampled through a convenience procedure. The researchers approached the teachers while the teachers were on recess. They were informed about the goal of the study and ensured the anonymity of their identity and the information they would provide. The main instruments used for data collection and analysis were questionnaires and interview guides. These instruments were used for triangulation purposes. The sample was administered the Instructional Methods of Teaching Climate Change Questionnaire (IMTCCQ). Quantitative data collected with the MTCCQ was analyzed using frequencies. Qualitative data was collected through a semi-structured interview guide on the Challenges Social Studies Teachers Encounter in Teaching Climate Change (CSSTCC). Nine junior high school Social Studies teachers at their convenience were interviewed. The respondents were randomly selected from the sample of 30. Data obtained from the CSSTCC interview schedule was analyzed descriptively. The interviews stemmed from the recommendation of Hennick and Kaiser (2022) that the point of saturation is normally attained at the fourth to eighth interview. The key disadvantage of using this design was the weak power of generalization of the findings. The sample was obtained through convenient sampling and, therefore, the sample is not representative of basic school Social

Studies teachers in the Assin Fosu Municipality in which the study was conducted. Therefore, the findings of the study are limited to the sample and only suggest that other junior high school Social Studies teachers in the Municipality may have similar views about climate change education. The study was carried out in the Assin Fosu Municipality in the Central Region of Ghana. The Municipality is situated in the north-eastern corner of the Central region and it is located in the moist semi-deciduous vegetation zone. The Municipality shares boundaries with Assin North District in the North, Birim South District in the East, Assin South District in the south, Twifo Ati-Morkwaa District in the West, and Upper Denkyira in the North-western part of the Municipality. The Municipality has a total land area of 675 km². The main economic activities in the Municipality consist of agriculture (farming), commerce, and service.

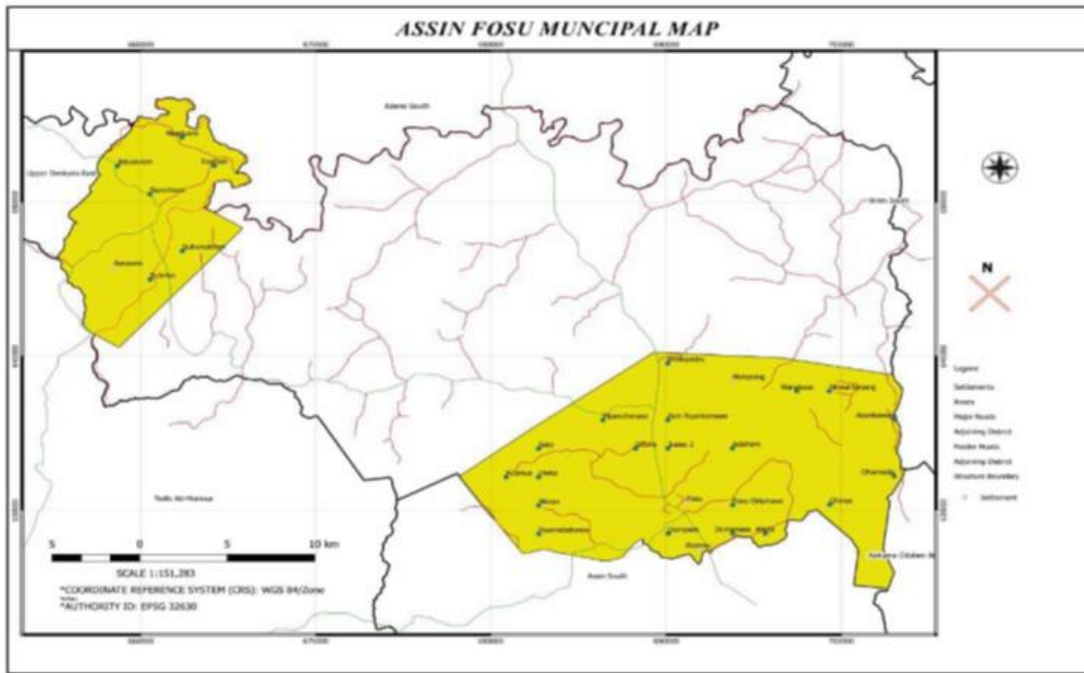


Figure 2: Map of Assin Fosu

RESULTS AND DISCUSSION

Teaching techniques employed by Social Studies teachers in teaching climate change

Table 1: Teaching techniques utilized by Social Studies teachers in teaching climate change

Instructional Technique	Frequencies & Percentages					
	Most of the time (f) <i>a</i>	Occasionally (f) <i>b</i>	% (<i>a+b</i>)	Rarely (f) <i>c</i>	Never (f) <i>d</i>	% (<i>c+d</i>)
Discussion	14	14	93.3	02	00	06.7
Lecture	06	16	73.3	04	04	26.7
Brainstorming	12	13	83.3	04	01	16.7
Role-play	05	13	60.0	07	05	40.0
Project-based	11	08	63.3	08	03	36.7
Simulation	04	14	60.0	08	04	40.0

Debate	09	07	53.3	08	06	46.7
Fieldtrip	16	05	70.0	04	05	30.7

Source: *Field Survey, Scale: M=4, O=3, R=2, N=1.*

From **Table 1**, the most common teaching techniques employed by Social Studies teachers to teach climate change are field trips, discussion, and brainstorming. These are represented by frequencies of sixteen (16), fourteen (14), and twelve (12) respectively. The table further revealed that the common teaching and learning techniques utilized by Social Studies teachers based on percentages are discussion (93.3%), brainstorming (83%), lecture (73%), field trips (70%), project-based learning (63.3%), role-play and simulation (60%), and debate (53.3%). This reveals that most Social Studies teachers at the junior high-level practice learner-centered method of teaching. This responds to Monroe, Plate, Oxarat, Bowers, and Chaves (2017) who disclosed that climate change education requires teachers to possess a repertoire of skills and knowledge that will salivate learners' interest in climate change lessons. This requires teachers to use pragmatic teaching techniques such as field trips, role-play, simulation, and discussion in teaching climate change.

Challenges Social Studies Teachers Encounter in Teaching Climate Change.

To inquire about the challenges Social Studies teachers, face in teaching climate change, nine semi-structured interviews took place three weeks after the sample completed responding to the questionnaire items. Each interview session lasted approximately 30 minutes. The interview was conducted outside the classroom during the break time. Below are excerpts from the interviews:

There are inadequate teaching and learning resources needed to teach climate change. This inadequacy does not make our lessons more practical and amusing to our learners. Climate change lessons require using of colorful and appealing teaching and learning resources that will sustain learners' interest during lessons. In our schools, there are inadequate teaching and learning resources to teach well during climate change lessons. Teaching and learning resources enhance learners' understanding of concepts however, their inadequacy clouds learners' understanding of climate change in terms of its causes, effects, and solutions.

(Respondent 1)

The inadequate funds to embark on field trips makes some of us teach the concept of climate change in the abstract to the learners. This does not make climate change education practical. Even most of us teachers learned it abstractly at college and university. We have come to know the fact that the concept of climate change is linked with our natural environment. This means that learners can learn better when they have access to witness things by themselves in specific locations. If teachers and learners are given the needed support to embark on field trips, we can teach and learn well about our environment and also build a bond with our environment.

(Respondent 2)

There is inadequate time on the timetable. Our lesson tables are packed and fixed. Our educational system does not allow flexibility in teaching. There is very little to non as to time allowed out for field trips and other practical learner-centered teaching techniques to tackle climate change. This limits our ability as Social Studies teachers to effectively teach climate change in Social Studies lessons. Climate change is a difficult strand that requires a lot of time for learners to understand certain facts and concepts. A lot of time is required so that learners can grasp the content being taught.

(Respondent 3)

Most of us teachers have a limited understanding of the concept of climate change concerning its causes, effects, and solutions. The low level of knowledge some of us possess makes climate change lessons not appealing to students to learners.

(Respondent 4)

When it comes to the pedagogical approach to teaching climate change, most of us are accustomed to the lecture mode of teaching and learning. This is because that was how we were taught at college and university during our teacher training programs. We also tend to tell our students what little knowledge we have acquired from our lecturers and also from books we read.

(Respondent 5)**Discussion.**

The Social Studies teachers who participated in the study often utilized discussions, debates, brainstorming, lectures, and field trips in their instructional process. Role-play, project-based teaching, and learning and simulation are the least instructional techniques Social Studies teachers use in teaching climate change. These are accordant with studies such as that of Khadka, Li, Stains, and Morgan (2020), who revealed that teachers utilize place-based education to heighten learners' interest in climate change lessons. This is synonymously to field trip methods of teaching in which the environment serves as the resource hub that accentuates hands-on, real-world learning that aids learners in developing an attachment to their natural environment. For basic school learners, learning within the environment induces their level of understanding of concepts that relate to our natural environment. Wise (2010), reported that teachers make prudent use of discussion techniques in climate change lessons. This technique provides a platform for learners to develop a deeper comprehension of climate change. According to Ahmed, Chowdhury, Ahmed, and Haq (2021), climate change education is a decisive element of climate change response, assisting learners to comprehend and solve the issues of global warming consequences, reinforcing learner's climate consciousness and fostering modification in their attitudes and behavior towards our natural environment. This points out that persistent climate change education helps learners to make rational decisions that play a relevant role in empowering them to reason critically to solve the challenges of climate change in our natural environment. A better understanding of climate change, its causes, practical mitigations, and solutions is a signal that points to climate change consciousness (Skarstein, 2020). The basic notion of climate change education is to equip learners with adequate knowledge, competencies, and skills that will make them environmental citizens who are poised to safeguard the environment from deteriorating (Nepras, Storejckova & Kroufek, 2022). In this process, the use of diverse instructional methods including techniques and strategies by Social Studies teachers in the teaching-learning processes will hone learners' skills and knowledge about climate change education. The challenges that Social Studies teachers encounter in teaching climate change include inadequate funds, inadequate time, inadequate teaching and learning resources, and inadequate teachers' level of knowledge on climate change. The outcome concurs with the findings of Mohammed (2016) and Monroe, Plate, Oxarart, Bowers, and Chaves (2019) on inadequate funds for field trips; Arko and Kporyi (2020), Akuamoah, Obeng-Ampadu, Asamoah, Baffo-Bonnie and Prah (2004), Field, Schwartzberg, and Berger (2019), and Bhattacharya, Steward, and Forbes (2020) on inadequate teaching and learning resources; Lombardi and Sinatra (2013), and Field, Schwartzberg, and Berger (2019) on inadequate teachers' knowledge; Plutzer, McCaffrey, Hannah, Roseau, Berbeco, and Reid (2016) on inadequate time of school time table.

Implications of the study

The study implies that climate change is one of the greatest challenges facing humanity. This proves the

seriousness of the problem of climate change and the urgent need to take action. For the foreseeable future, current and coming generations will be forced to relate to it throughout their lives. There is a need to prepare students for the challenges climate change poses. Therefore, continuous education in comprehending climate change and its causes and effects on our natural environment hinges on one primary key stakeholder- the teacher. Social Studies teachers' adequate knowledge of climate change education- their teaching techniques and the challenges they encounter in the teaching of climate change will help them improve upon their art and science of teaching and learning about climate change. This will in the long run help students to practice pro-environmentally friendly programs such as afforestation, ecological farming, and protection of forest reserves that would minimize the causes and effects of climate change in our natural environment.

CONCLUSION AND RECOMMENDATION

Social Studies teachers constantly serve as anchors for learners to acknowledge the changing trends in our natural environment. They maximize the practice of pro-environmental programs that will conserve our environment. The intensification of climate change education awakens learners to know the consequences that emanate from climate change. The junior high school Social Studies teachers who partook in the study employed varied instructional methods, techniques, and strategies in the classroom. The main instructional techniques utilized were field trips, discussions, debates, brainstorming, and lectures. In teaching climate change, the respondents revealed some challenges that obstruct the teaching of climate change which are inadequate teachers' level of knowledge, inadequate funds, inadequate time, and inadequate teaching and learning resources. The researchers recommend that teachers should practice learner-centered methods of teaching. Also, adequate teaching aids, in-service training, and funds should be provided to enrich teachers' effective teaching of climate change. Colleges of Education should emphasize climate change content and methods of teaching in their curriculum to build the capacity of trained Social Studies teachers. Also, the Ghana Education Service should strengthen the provision of continuous in-service training and competence development workshops on Social Studies, specifically on climate change, to bridge the knowledge gap among teachers. Again, the Ghana Education Service should strengthen efforts to motivate teachers to use varied teaching methods in teaching climate change in Junior High Schools to make learners pro-environmental citizens. More, instructional leaders should provide resources needed to Social Studies teachers for them to inspire their lessons to enhance learners' comprehension of climate change. Moreover, the Ghana Education Service and its stakeholders should review the Social Studies curriculum to incorporate field trips and more climate change education issues at Junior High Schools. The reason is to motivate teachers to make their lessons amusing and pragmatic. These are some potential strategies for addressing identified challenges.

Avenues for future research directions

It must be emphasized that this study forms part of other similar research conducted in different areas. The researchers wish to suggest that further research be conducted on the following areas:

1. Assessing the adequacy of climate change education issues in the junior and senior high school Social Studies curricula.
2. Assessing how Social Studies teachers were taught on climate change during their teacher training education.
3. Studies should be carried out to examine pre-service Social Studies teachers' perceptions of climate change education.
4. For generalization, this study should be replicated in several junior high schools in urban and rural

locations around the country.

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