Researcharticle

Role of Geography Education in Creating Climate Change Awareness: Middle Secondary School Teachers and Students' Perceptions

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ABSTRACT

This study adopted a Pragmatist paradigm to study the role of geography education in creating climate change awareness. Survey questionnaire and interview were used as data collection tools. The sample population consisted of 478 students and 16 geography teachers from 11 middle secondary schools under Tashigang Dzongkhag.The study found out that the middle secondary school teachers and students under Tashigang Dzongkhag have a high level of climate change awareness (M=5.1). Both the teachers and students agreed that geography education lacks climate change information (M=4.86). Majority of the students stated that they learn about climate change more from social media and mainstream media than from geography education. While the teachers and students perceived the causes of climate change differently, all of them agreed that it is prevailing.

The study also found resource constraints (M=4.3), time constraints (M=4.3), exam oriented (M=4.3), and teacher workload as some of the challenges in creating climate change awareness. Thus, the teachers and students felt the need of teaching-learning pedagogies such as field visit, project-based learning, group discussions, and inquiry-based learning so as to create climate change awareness. The participants also posited the need of treating climate change as a separate chapter and continued advocacy by the concerned agencies such as National Environment Commission, Royal Society for the Protection of Nature, and Bhutan Ecological Society.

Keywords: climate change, perception, level of awareness, , geography education, teaching and learning, curriculum.

Introduction

This paper presents general introduction, problem statement, aim and objectives, research primary questions and sub-research questions, study area, significance, limitations of the study and structure of the dissertation.

People from different walks of life understand and portray climate change differently. Climate change is widely accepted as the major threat of our time, posing unprecedented challenges to humanity. Climate Change is a vital issue to everyone. It is one of the pervasive and most threatening crises of present times. The United Nation Environment Program (UNEP, 2019) states that we are facing an existential threat and rapid prioritization of attention and action towards climate change awareness is necessary. If we continue with our current trend without proper mitigation and education, scientists predict that the consequences will be devastating and implications will be felt everywhere. Due to global warming and climate change: global temperature is rising; there is shrinking of ice sheets, glacial retreat and decrease in snow fields; and the sea level is rising and islands are submerging (Intergovernmental Panel on Climate Change (IPCC, 2010). Although many international and national initiatives to combat climate change issues have been researched and studied the risk still continues at a greater height.

Hossain et al. (2014) stated that Bhutan is a carbon-negative country and has demonstrated unparalleled leadership in fighting against climate change. Kamei et al. (2021) further revealed that the Himalayan country will remain carbon neutral by ensuring its emissions do not exceed the capacity of its forests to absorb them. Despite progress, Bhutan still has ways to go to understand and adapt to the impacts of climate change. Every year acres of forest are set on fire and hundreds of

saplings are destroyed. Wangchuk (2019) has reported that over 30124 acres of land were lost to forest fire. Apart from forest fires, emissions from motor vehicles are also a main contributor of climate change. Many Bhutanese love to ride their own cars to their workplace. The Road Safety and Transport Authority (RSTA, 2021) recorded that the number of vehicles has increased to 116926 which contributes huge emission to the atmosphere. In addition Gyeltshen (2012) states that even though Bhutan is a net sequester of greenhouse gases, the effects of climate change and variability are becoming increasingly visible. Precarious geographical location and effects of climate variability and change have highly exposed Bhutan to a diversity of hazards, including wind storms, flash floods, landslides, and glacial lake outburst floods.

The National Environment Commission (NEC, 2009) found that Bhutan's development and the economy are highly dependent on climate-sensitive sectors such as agriculture, hydropower, and forestry. The most significant impact of climate change in Bhutan is the formation of supra-glacial lakes due to the accelerated retreat of glaciers with increasing temperatures. The phenomenon is likely to intensify in the coming years as more melted ice joins these lakes. If left unchecked, it may wipe out the human settlement in the region within no time. Vulnerability to health risks posed by change in climate is becoming severe in Bhutan.

The United Nations Educational, Scientific and Cultural Organization (UNESCO, 2017) illustrated that education is an essential element of the global response to climate change. It helps the younger generation to understand and address the impact of global warming and increases climate literacy among young people, encourages changes in their attitudes and behaviour, and helps them adapt to climate change related trends. Education and awareness-raising programs enable informed decision-making, play an essential role in increasing adaptation and mitigation capacities of communities, and empower women and men to adopt sustainable lifestyles. UNESCO (2014) reported that education is critical in helping populations understand and address the impacts of climate change, and in encouraging the changes in attitudes and behaviour needed to help address the causes of climate change, adopt more sustainable lifestyles and develop skills that support different modules of economies, as well as to adapt to the impact of climate change. The concern is that, curriculum reforms suffer from time lags between the recognition that a change is needed to the actual implementation in curricula.

However, the need of raising awareness on climate change is important for accepting and addressing important behavioural norms by either reducing or improving the cause and bringing the desired change. This study examines the contribution and role of secondary school geography content in creating climate change awareness in Trashigang Dzongkhag.

Problem Statement

Climate change has become one of the pertinent threats. Despite the increase in the number of climate change issues discussed through conventions and studies over the years and its impact on the environment, there is a lack of awareness of knowledge amongst teachers and students on the climate issues and its impact on the environment in Bhutan. The Ministry of Education (MoE, 2018) found that out of 9574 teachers in Bhutan, only 60 teachers from schools across Thimphu attended a two-day workshop on climate across curriculum. This is the first of its kind of workshop in the country. Education institutions, being one of the biggest in Bhutan, have just started to train teachers on climate awareness programs very recently. Yangka et al. (2019) stated that the Royal Government of Bhutan made the commitment to remain carbon neutral at COP15 of United Nation Framework Convention on Climate Change in 2009. Bhutan reiterated the commitment under its Nationally Determined Contribution to the Paris Agreement in 2015 as a contribution to keep the planet safe for the benefit of present and future generations (Newman, 2018). Thus, Bhutan is one of the carbon neutral countries today. Tobgay (2016) supports that Bhutan generates only 2.4 million tons of $C0_2$, but our forests sequester as much as 6.3 million tons of $C0_2$ each year. Sinha (2020) further revealed that Himalayan countries such as Bhutan, erratic weather patterns, fast receding glaciers, and the risk of Glacial Lake Outburst Floods have now become stark reality. Climate change, if left unchecked, can become one of the biggest threats to humanity.

However, action to respond to climate change has been slow. UNESCO (2014)focuses on children and young people, as a key factor in helping to curb climate change. Education is an essential factor in the ever more urgent global fight against climate change. Amanchukwu et al. (2015) shared that knowledge regarding this phenomenon helps young people to understand and tackle the consequences of global warming, encourages them to change their behaviour and helps them to adapt to what is already a global emergency. Hermans (2015) supports that the educational institutions have subsidized the collective inability to act on climate change by failing to teach responsibility, engagement and consider education an untapped opportunity to combat climate change. Alex et al. (2017) supports that many education systems however have been found lacking content necessary to produce learners that will lead efforts in mitigating climate change. Content is a very important element of the education process. It forms the basis for teaching and learning.Geography as an interdisciplinary subject is most suitable to teach learners about climate change. Niemela and Terri (2018) support that knowledge and understanding of the atmosphere and the relationship between humans and their environment are now woven

into every level of the school geography curriculum and many teachers of geography make these prominent parts of their curriculum. Many education systems however have been found lacking content necessary to produce learners that will lead efforts in mitigating climate change. Content is a very important element of the education process. It forms the basis for teaching and learning. Geography as an interdisciplinary subject is most suitable to teach learners about climate change. Though there are climate studies conducted in the country, studies related to climate change awareness were not studied based on teachers and students' understanding of climate change awareness. Secondary school geography curriculum contents must address climate change, global warming and environment hazards. However, scope and depth of coverage varies with the need to addresses the present situation. In Bhutanese context, A Geography of Bhutan course book for classes IX and X published by Royal Education Council (REC, 2018), has 12 chapters but none of the chapters specifically discusses climate change. Thus, introducing the climate change strategy into the Bhutanese classroom is likely to cater to the above problem. This study explores how geography education enhances the knowledge and understanding of climate change awareness for the teachers and students. Further, this study assesses the perception and level of climate change awareness, and behavior changes of students and teachers in regard to climate change.

Research Questions

Primary Research question

What is the perception of middle secondary school teachers and students on the role of geography education in creating climate change awareness?

Sub-Research Questions

1. How do teachers and students perceive climate change?
2. What are teachers' and students' current level of climate change awareness?
3. How do teachers and students perceive the role of geography education in promoting climate change awareness?
4. What are the challenges in creating climate change awareness through geography education?
5. What are the strategies in enhancing climate change awareness through geography education?
6. What are the behavioural changes in teachers and students as a result of teaching and learning geography?

Significance of the study

Currently climate change is one of the major issues and combating it is considered as a daunting task. Therefore the study will help in creating awareness on climate change among students, teachers and other stakeholders. There is limited Bhutanese literature on climate change and its awareness. This study will add to existing literature and knowledge on the role of geography education in creating climate change awareness.

The findings of this study will benefit organizations like National Environmental Commission, Clean Bhutan and National Environmental Trust Fund who are associated with climate change related matters. The study will inform them of the causes and consequences of climate change.

This study will further encourage teachers and students in the country to become responsible citizens and climate ambassadors in creating climate change awareness in their community and nation as a whole. Particularly to teachers, it will encourage them to incorporate climate change awareness in their daily lesson plans and will help to design activities that will enhance awareness on climate change. This study has the scope of helping younger generations understand climate issues and develop climate responsible leaders in future. The study will disclose the teachers' knowledge on climate change and the way it is used in the school. It will also reveal the benefits and drawbacks of climate change. The findings from this study can generate knowledge that can be shared with stakeholders (MoE, REC, and Metrology) so that they work towards implementation of climate change as instructional measures at the national level.

Lastly, this study has the potential to encourage teachers and students to take up initiatives related to climate change awareness programs with the support from international organizations such as UNICEF and UNESCO and national organizations like National Environment Commission and Bhutan Environmental Trust Fund. They can also organize activities and programs that will contribute towards enhancing climate change awareness.

Literature Review

This section discusses a review of the related literature based on the following topics: perception of climate change, teachers' and students level of climate change awareness, role of geography education in creating climate change awareness, educational strategies and initiatives creating climate change awareness, challenges in creating climate change awareness and behavioural changes after teaching and learning geography.

Teachers' and Students' perception of climate change awareness

Climate change is perceived differently by different people around the world. Understanding public perception on climate change play an important role in designing solutions to reduce the impact of climate on communities. For example, Wang et al. (2018) found that understanding public perceptions of climate change is critical in order to build widespread public engagement, and to develop effective communication and educational approaches. Lekgeu (2017) conducted a research on students' perception on climate change and identified notable differences between participants across different schools and of different ages. Hansen et al. (2012) revealed in their study that the people perceived that the greatest barrier to public recognition of human-made climate change is probably the natural variability of local climate. Benoit (2015) stated that green-house gas is the single most human-induced factor that causes climate change. The findings from similar studies by Ursavas and Odabasi (2021) also pointed out that the greenhouse effect was completely an anthropogenic phenomenon rather than a naturally occurring process, and it is something not good for the earth. A similar study by Mbah and Apollo (2021) suggested that teaching should not precisely focus on explaining climate science but also create awareness of the impacts of climate change on humanity and the environment. The need for the teachers' awareness on the climate change has become paramount, as it has a ripple effect on students. However, Dal et al.(2015) found that teachers do not have adequate knowledge to develop awareness and spread it to others. A similar outcome was also stated in a study conducted in Turkey by Celikler and Aksan (2019), which showed that teachers' awareness on environmental issues was inadequate. Each of the studies above indicates that teachers have problems with awareness of the Earth system relationships and the impact of human activities on Earth systems. The finding is consistent with Huho and Seow (2015), where it was also found that the students are less aware of climate change. He further explained that when teachers fail to inform students about climate change, it is very difficult for the students to build climate change awareness.

Teachers and students level of climate change awareness

Teaching climate change concepts at all levels of formal education is important to tackle climate change and teachers must be able to explain the concepts underlying the causes, impacts and solutions of climate change as accurately as possible to the learners. Middle Secondary School students and teachers in Hongkong also have demonstrated a high level of awareness on climate (Pascua & Chang, 2017). Similarly, Kuthe et al. (2019) also found that climate change awareness among the students was high in Bangladesh. However, Ekpohand Ekpoh (2011) found Kalabar Secondary School teachers in Nigeria with low levels of climate change awareness. The authors attributed this to lack of government support in sensitizing the public on climate change. The findings of Cords (2019) revealed that the Finnish children and teens are increasingly worried about climate change. It may be concluded that children in Finland are more aware of climate change than others. Similarly, Kabubo-Mariara and Karaja (2007) and Maude (2020) stated that most Kenyans and Philipinoes are aware of changes in climate respectively. Education should be able to address the most emerging issue of the time that is climate change.

Sources through which teachers and students become aware of climate change are various social media and mainstream media. Barreda (2018) found that the internet and social media as important channels that could enhance their level of awareness. It was further found that a youth's personal experience could provide the impetus to address climate change. Camera et al. (2020) stated that mass media such as radio and television improved students' awareness by regularly broadcasting information on climate change. Further, Dlamini (2017) conducted a study in South Africa and found that the geography textbook does not contain scientific information but indirectly climate change is introduced in the textbook. However, he found that mass media plays an important role in influencing teachers and students perceptions and understanding on climate change. On the contrary, Melia (2019) stated that information presented through social media is broken, old, misleading, not scientifically sound, and not sound technically and further misinforms the learners. Bondoc(2015) and Bello (2014) also found that parents and schools are the main source where students become aware of climate change. However, Gifford et al. (2011) believe that education is an essential element of the global response to climate change. Knowledge of climate change is perceived as a part of environmental education that helps in development of a sense of responsibility through the creation of

informed awareness. They believed that students' personal experiences play an important role in knowledge building and attitude formation.

Role of geography education creating climate change awareness

Geography is regarded as an important vehicle through which environmental education can be taught (Erhabor & Don, 2016; Nyumba et al., 2018). Erhabor and Don (2016) believes that geography education plays an important part in environmental education, which helps people acquire the awareness of the earth, natural resources and their value. Geography education helps in enhancing environmental knowledge and promoting environmental attitudes and behaviour of the learners. The REC (2017), has infused climate education in geography textbooks and will contribute greatly in creating climate change awareness and its impact in our lives and livelihood. Geography subject plays an important role in creating climate change awareness as it deals with earth and environment. Erhabor & Don (2016) and Lindell (2012) found that geography education has a provision to create climate change awareness. But Kariuki (2017) asserted that the curriculum of most developing countries, especially in Africa, show a critical shortage of climate change content at all educational levels from primary to tertiary levels. Limited topics in the textbook and fewer activities have hampered teachers imparting climate related issues to the students. The findings of McNeal et al. (2017) also argue that simply adding climate change to the existing curriculum is not sufficient for teachers or students. It was clear that teachers should play an extra role in helping the students better understand the climate change events. Similar findings were also indicated in Nation et al. (2017), that curriculum had resulting impacts on the teachers' instruction of climate change, and on student outcomes. UNESCO (2011) encourages countries to promote, develop and implement educational, training and public awareness programmes on climate change and its effects. Education for mitigation and adaptation is espoused as the key strategy to building climate literacy. Chang and Pascua (2017), states that nations are engaging schools to teach the issue of recent climate changes, specifically global warming, to equip learners with functional knowledge on how to mitigate and adapt to anticipated warmer global conditions.

Geography education is positively associated with environmental awareness. There are some empirical studies about the direct connection between environmental concern and education. For example, Shen and Saijo (2008) found in their study that a high education level with a college degree or above creates more environmental concern among college students. Well-educated people tend to be more concerned about environmental quality than less educated people. According to Rahman (2013), educated people are more concerned about their surrounding environment and they have better access to information about the environment. Well planned education programs help in improving awareness of energy improving actions and climate change awareness (Cordero et al., 2008).

Educational strategies and initiatives to create climate change awareness

Ever since climate change had been accepted as one of the most important issues of the new century, individuals' behavior, perceptions, their knowledge and awareness in relation to climate change mitigation and adaptation have started becoming the focus of research studies (Whitmarsh & Capstick, 2018). It is very important to provide teachers with the competencies to teach climate change in geography classrooms. It is very important to provide teachers with workshops on topics such as awareness and adaptation to climate change, which integrates instruction and teaching activities and creates opportunities for teachers who are already in the workforce to keep up with the changing nature of knowledge and follow recent scientific developments.

Educational strategies and initiatives on climate change is important to prepare students for the adaptation and mitigation related to climate. The study conducted by Spiropoulos (2020) found that conducting field studies on climate change enhanced students' knowledge related to the same and they could articulate the local impacts of climate change. Further, Shirazi (2009) shared that field observation like change in rainfall pattern, change in cropping pattern and migration of the animals helped both teachers and students aware of climate change. However, the study by Parant et al. (2017) argued that an expanded learning environment beyond the classroom was not seen as an important feature of teaching methods, although they could offer good possibilities for place-based learning. Wroblewska and Okraszewska (2020) revealed similar findings that project based learning had a significantly greater effect than traditional learning. The study is also in line with Winthrop and Kwuak (2021) who noticed that students got motivated to know more about climate change after participating in several projects. They reiterated that posters use the same ideas more directly and thereby allowing students to advocate and promote climate change awareness. However, the finding is in contrast with Sun et al. (2021) where their results indicated that educational posters did

not increase students' support or involvement in the climate change, which illustrates that visualization of information did not increase participants' engagement in climate change actions either.

Challenges in creating climate change awareness through geography education

Climate change is a pressing issue that requires worldwide action as well as a shift in thinking and decision-making to account for negative human-environmental interactions. Education was recognized for its potential to empower, inform, and motivate those participating in climate change action, as well as the broader public and government. Curriculum-based, community-based, and technology-based approaches were all given as examples of how to integrate climate change into education (Thunberg, 2019). However, reaching students and the general public with climate change education and awareness was difficult. Schools should be provided with adequate facilities like weather station, geography lab and monetary to create climate change awareness among the students. Maarouf (2019) found that lack of physical facilities and software like Geographic Information System (GIS) and Remote Sensing (RS)in the schools are the main barrier in effective climate change communication in the classrooms. Further it was found that limited teaching time in the class obstructs the time they devote to climate change related content. Subedi (2016) pointed out that both teachers and students need to have good knowledge on GIS and RS so that they will be able to locate climate affected areas. He further revealed that the mark-oriented education system in Nepal is a barrier in imparting climate change education. Crayne (2015) also added that resource deficits prevent teachers from focusing more on climate change issues. Even though Ajuang (2016) reported that students will be well informed if climate change concepts were introduced in all level of formal education, the study found that there is less information on climate studies included in lower grades and there is less connection on climate change between key stages.

Behavioral changes after studying geography education

Changing teachers and students behavior is very important as it has direct impact on our surrounding. After teaching and learning climate change and its issues in the class, there need to be change in behavior to address the climate change. Yildirim and Akar(2021) and Rocha et al. (2020) exhibited that climate change education has brought climate-friendly behavior to the students. Similarly, Wamsler (2019) also asserted that mindfulness has the potential to contribute to facilitating climate adaptation at all scales, from the individual to the institutional and societal levels. This was highlighted in a study conducted by Walfisz (2021). He stated that addressing climate change requires a profound behavioral revolution, which can only be achieved through adequate interdisciplinary and systems-based education. In addition, Lauwrens (2020) also believed that the benefits of children gaining climate awareness can continue at home and encourage the broader community to practice the same habits. For example, after learning to use water sparingly at school, students can practice closing dripping taps at home.

Climate education is an important agent to nurture our youth to have a valuable contribution in controlling climate change. Hermans (2016) and Rocha et al. (2020) found that there is behavior change among the teachers in Finland and Brazil due to teaching of geography education to the students. Therefore, the schools should organize more climate-related awareness programs to minimize the impacts of climate change.

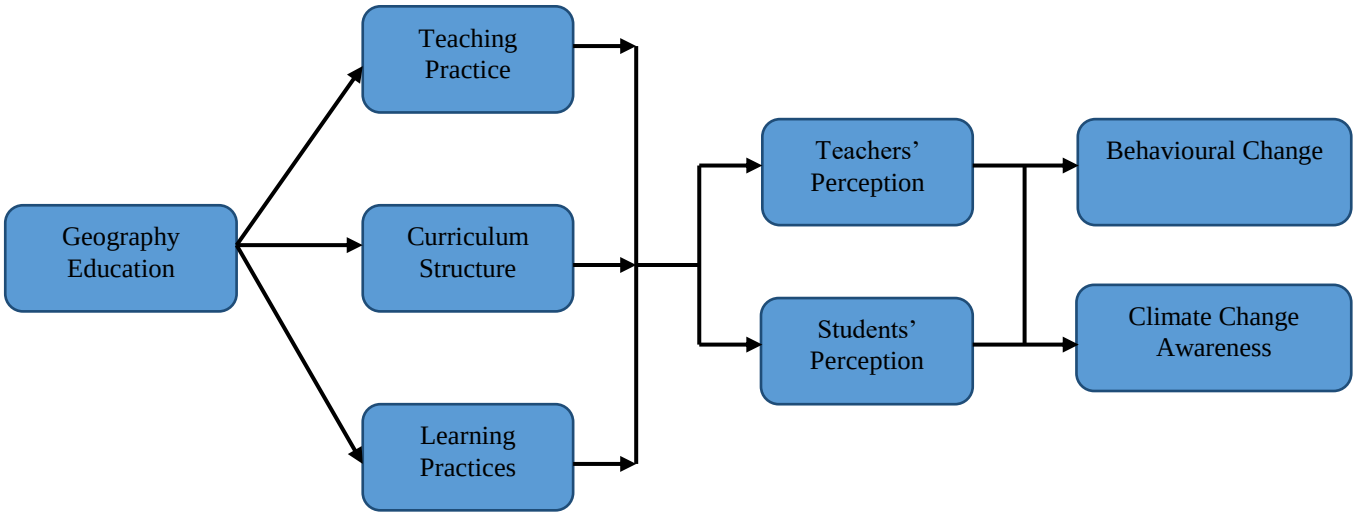
Education is vital for the students' to thoroughly prepared for the changing climate and make sure everyone is prepared for an uncertain future. Whitmarsh and Capstick (2018) indicated that people are more likely to adopt environmentally responsible behavior when they are informed about the consequences of pollution as the knowledge of the causes of climate change has been shown to be a key predictor of behavioral intentions to address climate change. Similar findings are shared in Mbah and Apollo (2021) that most teachers believe that climate change should be taught in schools. The findings also fit with the findings of Bevins (2020), who found that climate change education is important for teachers and wanted to know more about climate change, so they could inform their students about the climate change.

Theoretical Underpinning and Conceptual Framework

This research is guided by the theory of Behaviorism. According to Williamson et al. (2018) solving the global climate change crisis is going to rely on, in one way or another, changing human behaviour. Transforming human behaviour is more important than any other to fight for climate change. UNESCO (2017) found that education is an essential element of the global response to climate change. It helps people understand and address the impact of global warming, increases climate literacy among young people, encourages changes in their attitudes and behaviour, and helps them adapt to climate change related trends. The research question on the level of awareness of climate change needs significant behaviour change among individuals. Reid (2019) found that education plays a paramount

role in raising awareness and promoting behavioural change for climate change mitigation and adaptation. Malandrakis et al. (2011) found there is a strong link between a person's general environmental attitudes and knowledge, and his or her willingness to undertake pro-environmental actions. Human beings are the single most factor that contributed for the climate change and time has come for human to look for solution to control climate change. Williamson et al. (2018) believed that most of the climate change causes are human, it must be human behaviour that needs to be changed to control climate change by creating awareness and developing strategies in their community to adapt and mitigate climate change. UNESCO (n.d) states that they had been encouraging innovative teaching approaches to integrate climate change education in school and by raising awareness about climate change as well as enhancing non-formal education programmes through media, networking and partnerships.
Teaching and learning practices and curriculum structure are prominent aspects of geography as a subject from pedagogy perspective. How teachers perceive climate change awareness is determined by teaching and students' perception on climate change awareness is determined by learning. With the help of teaching and learning practices and curriculum structure, it will further explore middle secondary school teachers and students' perception on climate change awareness.

Figure 1: Conceptual Framework



Methodology

This paper presents the methodology employed to carry out the study, such as research paradigm, design, approach, instruments, reliability, and validation of instruments, variables, study area, sample size, data collection, data analysis and ethical consideration.

Paradigm

Therefore, this study was guided by pragmatism as a research paradigm, since its aim is to explore teachers' and students' perception on climate change awareness through the study of the geography education.
Kivunjaet al. (2017) support pragmatic paradigm as it is more practical and pluralistic approaches that allow a combination of methods, in conjunction could shed light on the actual behaviour of participants, the beliefs that stand behind those behaviors and the consequences that are likely to follow from different behaviors. Furthermore, Gurunget al. (2017) also stated that while studying the perception of the teachers and students, mixed methods would be more appropriate for data triangulation. It also allows the individual researchers to have freedom on the choice of methods, techniques and procedure of research that best serves researchers desires and purpose (Creswell & Creswell, 2018).

Research Approach

This study employed mixed methods approach as it offers a better ways of addressing the current research problem than qualitative and quantitative in isolation. Mixed methods research has been described in a variety of ways which can make it a difficult concept to understand (Niglas, 2009).The key characteristics present in most definitions of mixed methods research are the inclusion of both quantitative and qualitative strategies at different levels of the study and the integration of thinking resulting from the use of both types of strategies (Maxwell, 2016).The study focuses on finding of both qualitative as well as quantitative data in order to have a detailed understanding of teachers' and students' perception on climate change awareness through the study of geography education. According to Creswell and Creswell (2018), mixed methods research resides in the middle of the continuum because it incorporates elements of both qualitative and quantitative approaches. Additionally, this approach (integration of qualitative and quantitative) yields additional insight beyond the information provided by either the quantitative or the qualitative data alone (Creswell & Creswell, 2018). By using mixed methods design, the strengths of one method, overcomes the limitations of another method. Hence, it validates the practice in the current context of the study to understand teachers' and students' perception on the awareness on climate change through geography curriculum.

Research Design

This study employed convergent parallel mixed methods as research design. Convergent parallel as a design enables researcher to collect both quantitative as well as qualitative data concurrently. Taber and Tayler (2009) consider the term convergent parallel mixed designs to be more inclusive than simultaneous designs. Furthermore, Cresswell (2018) believes that convergent parallel mixed methods will help investigator typically collect both forms of data at roughly the same time and then integrate the information in the interpretation of the overall results. He further explained that design is a form of mixed methods design in which the researcher converges or merges quantitative and qualitative data in order to provide a comprehensive analysis of the research problem. Adapting this research design can compensate on the weakness of each approach which will help to get an appropriate data. Therefore, given the limited time of two weeks for data collection, this design was found the most suitable as it enable to collect data in simultaneously in short span of time.

Target Population

For this study, target population includes Class IX and X students and Geography teachers. Though concepts related to climate are introduced in the lower classes, students are introduced extensive ideas of climate and climate change through geography education in class IX and X and they are more familiar with climate change.

Sampling Technique and Size

Quantitative Data Collection Strategies

Stratified simple random sampling techniques were adopted to select participants in this study. This technique is considered unbiased, and able to achieve randomization for the generalization of the results of this study to the entire area. Students who responded to the questionnaire were randomly assigned by their teachers who aided the administration and retrieval of the questionnaire. The use of teachers as research assistants is for increased accuracy in students' responses and full retrieval of the all distributed questionnaire.

Qualitative Data Collection Strategies

As informed by the research design convenient sampling was used to collect qualitative data. According to Etikanet al. (2016), in every type of research it would be superlative to use the whole population but in most cases it is not possible to include every subject because the population is almost finite. This is the rationale behind using sampling techniques like convenience sampling. Convenience sampling is affordable, easy and the subjects are readily available. Convenience sampling techniques is applicable to both qualitative and quantitative studies. In convenience sampling researchers select subjects that are more readily accessible. However, opportunity to participate is not equal for all qualified individual in the target population and study results are not necessarily generalizable to the population. The study administered convenience sampling as the schools in the study area restrict visitors and it was very difficult to get the interview participants. Thus, requested over the phone, after their confirmation, zoom and telephone interview was

conducted. One geography teacher from each school participated in the interview and while 6 students participated infocus group discussion from 11 middle secondary schools.

Sample Size

Therefore, for this study, sample size for both quantitative and qualitative data are selected not based on assumption rather it was done with the rational of fulfilling the requirements of efficiency, representativeness, reliability, and flexibility. The widely used sample size determination formula documented in Yamane (1967), was followed to obtain 400 as the appropriate sample for this study ($n= N/1+Ne^2$). However, the researcher decided to distribute 591 copies of the survey questionnaires to avoid shortages of returned instrument. Eventually, 113 were rejected and 478 was achieved through proper administration. In total 478 students from middle secondary school of Trashigang Dzongkhag participated anonymously. All the geography teachers who were teaching geography of Class IX and X took part in the survey out of which 10 were males and 6 were females.

Table 1: Student Survey participants

	Class IX		**Class X**		**Total**	**Total Sampling (IX)**		**Total Sampling (X)**		
	M	**F**	**M**	**F**	**T**	**M**	**F**	**M**	**F**	**T**
Dungtse MSS	55	64	70	66	255	15	11	12	13	51
Radhi MSS	13	12	6	13	44	5	4	6	5	20
Rangjung CS	33	35	43	43	154	6	15	11	8	40
Bartsham CS	60	72	70	77	279	18	14	11	11	54
Trashigang MSS	27	26	8	25	86	5	8	6	6	25
Jampeling CS	36	46	35	39	156	13	11	5	14	43
Udzorong CS	28	36	36	33	133	12	11	14	14	51
Jigmesherubling CS	51	54	34	45	184	10	11	10	18	49
Gongthung MSS	25	34	25	30	114	10	10	6	14	40
Tashitse HSS	31	46	40	39	156	10	11	12	21	54
Thrimshing CS	46	58	51	63	218	12	15	12	12	51
Total	**405**	**483**	**418**	**473**	**1779**	**116**	**121**	**105**	**136**	**478**

Table 2: Teacher interview, teacher survey participants and student focus group discussion

	Teacher Survey		
	Teacher	Students	Participants
Name of the school	Total	Total	Total
Dungtse MSS	1	6	3
Radhi MSS	1	6	1
Rangjung CS	1	6	2
Bartsham CS	1	6	1

Trashigang MSS	1	6	2
Jampeling CS	1	6	2
Udzorong CS	1	6	1
Jigmesherubling CS	1	6	1
Gongthung MSS	1	6	1
Tashitse HSS	1	6	1
Thrimshing CS	1	6	1
Total	**11**	**66**	**16**

In order to make findings valid and reliable, teacher interview and students Focus Group Discussion (FGD) were used for this study to collect qualitative data to study teachers and students perception on the level of the awareness. FGD is a technique where researcher assembles group of individuals to discuss a specific topic, aiming to draw information from the complex personal experiences, beliefs, perceptions and attitudes of that the participants through a moderated interaction (Morgan, 1996, p. 129).

Data Collection Techniques

Survey: According to Onuoh(2021), survey is the process of collecting data through a questionnaire that asks a range of individuals the same questions related to their characteristics, attributes, how they live and their opinions. Survey as a technique for collecting quantitative data was adopted since it is faster, more accurate, cost-effective and can be analyzed fast using statistical tools. Quantitative data on teachers' and students' understanding of the climate change through the study of geography curriculum is collected using survey questionnaire. The survey questionnaire for teachers consisted of two sections-A. demographic profile of participants and B. survey questionnaires with 60 items. Student's survey questionnaires consist of two sections – A. demographic profile of the participants and B. survey questionnaires with 52 items. Teachers' and students' perception on climate change and the curriculum inclusiveness was measured using statements with six-point Likert scales as (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Somewhat agree, 5= Agree and 6= Strongly Agree).

Focus Group Discussion (FGD): There are different techniques to collect qualitative data. Focus Group Discussion was found to be an appropriate method for the study to collect data from students. According to Mishra (2016) focus group discussion is a good way to gather together people from similar backgrounds or experiences to discuss a specific topic of interest. Rock et al. (2007) reported that the main methods of data collection during a FGD include audio and tape recording, note-taking and participant observation. Morgan and Kruger (1998) believe that each of these methods presents both advantages and disadvantages, thus the researcher should carefully select the method based on the context. For this study, the researchers had used audio recording and note taking to collect data during the FGD. The duration of FGD ranged from 30 to 40 minutes with six participants from each school randomly, depending on their willingness. This was to ensure that students don't get distracted due to long FGD sessions. As Stewart and Sullivan (2019) stated the focus group should have six to twelve participants. They further added that if it is less than six, the discussion will be dull and if it exceeds twelve, it will be difficult to manage the group.

Interview: Interview is an important data gathering technique involving verbal communication between the researcher and the participants. Fox (2009) stated that range of approaches to interviewing, from completely unstructured in which the participants is allowed to talk freely about whatever they wish and in structured

participants response are limited to answering direct questions. The study administered semi-structured interview, as most of the questions asked were planned in advance and open-ended questions. The study employed face-to-face interview for 6 schools and rest 5 schools were conducted through zoom meeting as their schools were completely restricted for visitors. Some probing questions were asked in between to get required information.

Validity and Reliability of the Instruments

The questionnaire was subjected to face-validation for appropriateness, relevance, clarity and suitability for the study, with improvements on the final output. Trial testing of the questionnaire was done in one of the middle secondary school in Tashigang Dzongkhag for the determination of its internal consistency. The Cronbach's alpha reliability statistics of the items on the questionnaire yielded a very high coefficient of .93 for teachers and .89 for the students and is considered both valid and reliable. All ethical procedures, especially of the confidentiality of the respondents and related information, expected of a study was adhered to.

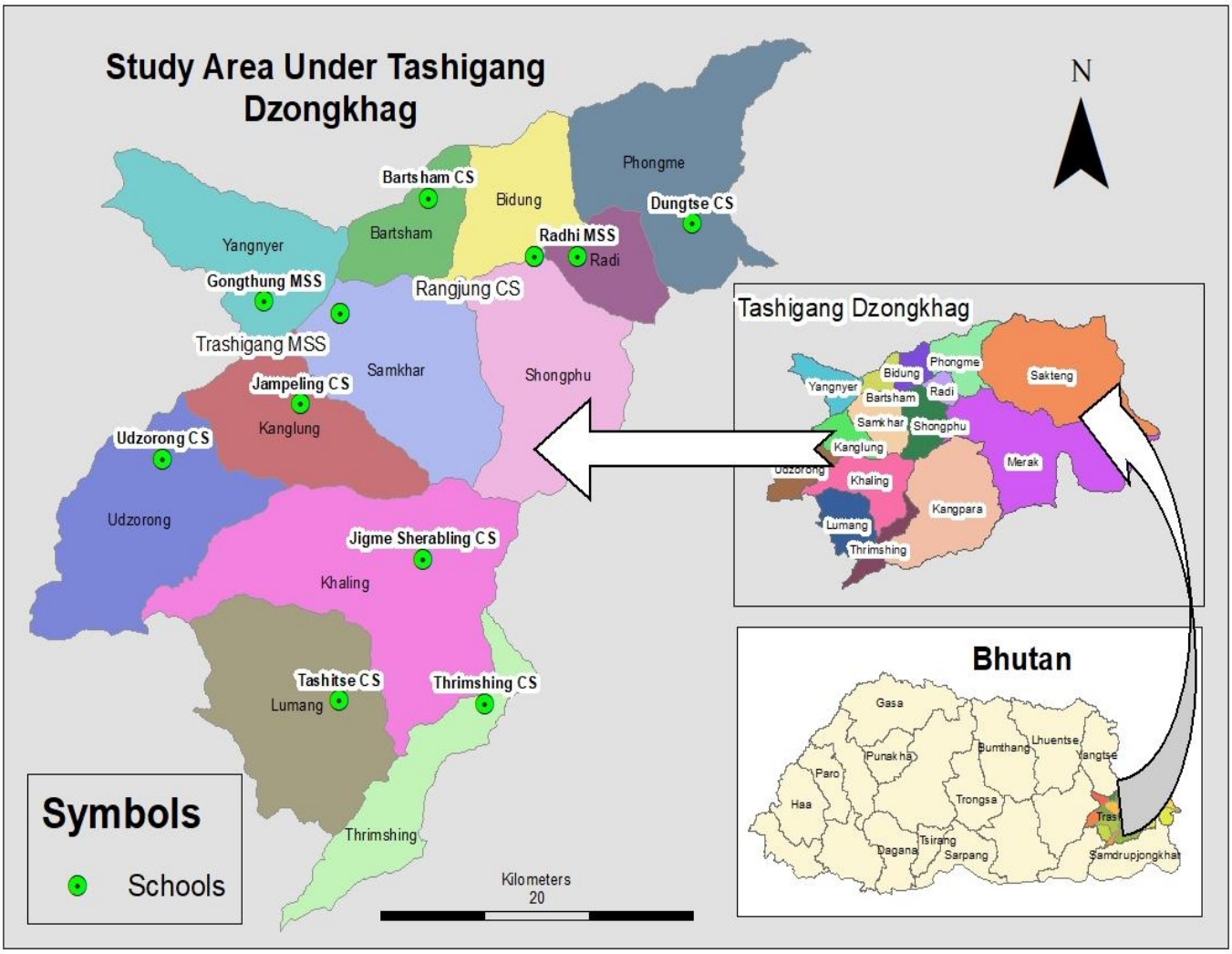
Data analysis

Survey Questionnaire: The sum and averages of each student's responses to items on the questionnaire were first obtained and converted to percentages, based on the total expected maximum scores. The mean and percentage score derived for each student is adopted to represent the level of climate change awareness of that student. Statistical analysis is used to study the data collected and for data cleaning. Descriptive statistics such as mean and standard deviation is used to describe and summarize geography teachers and students' level of climate change awareness, perception on climate change awareness and behaviour changes occurred. All respondents scores were further calculated in mean for further analysis. Students and teachers level of climate change awareness is categorized into five levels based on mean score- Very High (5.1-6), High (4.1-5), Moderate (3.1-4), Low (2.1-3) and Very Low (1-2). Statistical Package for the Social Science (SPSS) was used for analyzing the quantitative data.

FGD and Interview: For the qualitative data analysis, procedure of the thematic analysis was followed. The data from the focused group discussions and interviews were transcribed, coded and categorized into various themes. Data collected were analyzed and correlation was conducted between teachers' and students' perceptions and their behavior change towards climate change. The summation of students' responses to the instrument yields a climate change awareness score. All respondents scores were further calculated in mean for further analysis. Through focusing on meaning across a dataset, it allows the researcher to examine the collective or shared meanings and experiences. This method is a way of identifying what is common to the way a topic is talked or written about, and of making sense of those commonalities. Moreover, direct quotations of participants' responses to the interview questions were also presented because in descriptive analysis it is important to make use of direct quotations from the participants and discuss the findings based on these quotations to ensure validity.

Study Area: Trashigang District is located in Eastern part of the country with an area of 2204.5 sq.kms comprising of 15 Gewogs and 79 Chiwogs. The district has five higher secondary schools, eleven middle secondary schools, six lower secondary schools, thirty five primary schools and three ECRS with 11062 students (Dzongkhag Education Statistics, 2020). This study was conducted in 11 middle secondary schools. Geography subject particularly deals with the environment related issues and student get to study in explore about climate related issues in Class IX and X. With this understanding researcher has chosen Class X and IX as the study participants since, researcher is well acquainted with the area and the time spent on rapport building can be reduced and an appropriate time can be given to data collection and fieldwork. Moreover there is good number of middle secondary schools. Altogether, it counts in having the right sample size to add validity, conformity, and reliability to this study.

Table 3: Study area showing Middle Secondary Schools of Trashigang Dzongkhag



Ethical considerations

All ethical issues that need to be addressed in the whole process of this research were dealt and adhered stringently following as per the ethical or research code of conduct principles and regulations prescribed in Zhib 'Tshol, Royal University of Bhutan Research Policy (Royal University of Bhutan, 2014). Official approval from the College Research Committee, Samtse College of Education, followed by a consent letter of college authorities to conduct this research was sought. Approval from Dzongkhag administration and school administration were also sought for conducting the research. Participation in the study was voluntary and all participants for the research were explained in detail the purpose of the research and their role as research participants. Participants were provided with a consent form to be duly signed. Upon the completion of the study, a compiled comprehensive report along with data collected for the research shall be submitted to the College Research Committee as part of the academic mandate, and a copy of the report shall be submitted to the participants if they request for a copy. Publication in journals and presentation in conferences will only be done based on prior permission from the College Research Committee.

Results

This section presents the results generated from the quantitative and qualitative data followed by discussions. The results and discussion are presented under six broad themes; perceptions of the teachers and students on climate change, teachers' and students' level of climate change awareness, role of geography education in creating climate change awareness, challenges in creating climate change awareness through geography education, teaching and learning strategies that promotes climate change awareness and behavior changes on teachers and students after studying climate change.

Demographic information

A total of 16 teachers participated in the survey out of which 10 were male and 6 were female from 11 middle secondary schools of Trashigang dzongkhag. Further, 11 teachers also participated in the interview. Majority of the participants have teaching experiences of more than 6 years with the minimum qualification of Bachelors in Education.

A total of 478 students from 11 secondary schools from Trashigang dzongkhag participated in the survey. Further, 66 students participated in FGD. Out of 478 participants, 221 were male (46.2%) and 257 were female (53.8%). A total of 256 participants are from semi-urban and 49 from urban schools. Out of 478 respondents, the highest number of the respondent are in the age group of 15 to 20 (80.1%).

Table 4: Demographic information of teachers and students participants from Middle Secondary Schools of Trashigang Dzongkhag.

General Information		Teacher Participants	Percentage (%)	Student Participant	Percentage (%)
Total		16	100 %	478	100 %
School	Gongthung MSS	1	6.3	40	8.37
	Uzorong CS	2	12.5	51	10.67
	Radhi MSS	1	6.3	20	4.18
	Trashigang MSS	2	12.5	25	5.23
	Rangjung CS	2	12.5	40	8.37
	Dungtse CS	3	18.8	51	10.67
	Bartsham CS	1	6.3	54	11.3
	Jampeling CS	1	6.3	43	9
	JigmeSherubling CS	1	6.3	49	10.25
	Thrimshing CS	1	6.3	51	10.67
	Tashitse CS	1	6.3	54	11.3
Gender	Male	10	62.5	221	46.23
	Female	6	37.5	257	53.77
Teaching Experience	Below 5 years	2	12.5		
	6 – 10 Years	5	31.25		
	11 – 15 Years	4	25		
	Above 16 Years	5	31.25		
Qualification	B.Ed	7	43.75		
	PGCE/PGDE	6	37.5		
	M.Ed	3	18.75		
Location of School	Urban	2	12.5	49	10.25
	Semi-urban	6	37.5	256	53.56
	Rural	8	50	173	36.19
Class	IX			236	49.37
	X			242	50.63
Age	Below 15			94	19.67
	15 to 20 years			383	80.13
	Above 20			1	0.2

Teachers' and students' Perception on Climate Change

Table 5: *Teachers' perception on the climate change*

Items	Mean	SD
Climate change is not a national concern but global concern.	6.0	0.0
Climate change is a global threat.	5.9	0.3
Climate change is global concern caused by the developed nations.	5.4	1.1
All the human activities are responsible for the climate change issues.	5.4	0.9
Problems and impacts of climate change are underestimated in the news.	4.6	1.1

Climate change is real.	5.6	0.5
It is late to combat climate change.	2.6	1.4
Each one of us can contribute in combating climate change issues.	5.8	0.4
Climate change is bound to happen because of industrialization.	5.6	0.6
I am responsible for promoting a greener environment to combat climate concerns.	5.6	0.6
Total	**4.9**	**0.8**

Table 5 shows the mean score of teachers' perception on climate change awareness (M=4.9, SD=0.8), indicating that the participating teachers have a high level of perception on climate change awareness. Of the 17 items, "climate change as a global concern" is rated the highest (M=6, SD=0.0).The item, "It is late to combat climate change" is rated the least (M=2.6, SD=1.4).

Teacher 5 perceived that "it is important to have knowledge on climate change. It is essential to have intensive awareness of climate change as the temperature of the world keeps on rising due to the emission of CO_2." Teacher 8 believed that the impact of the climate change such as crop failure, glacial lake outburst and change in rainfall pattern in their area are the result of climate change. "Mother earth is heavily burdened and now it is important to encourage each and every one to be mindful about their actions towards mother earth" (Teacher 4). However, the study found that most of the students are unaware about climate change and its consequences (Teacher 2 and 9).The item "each one of us can contribute in combating climate change issues" with a high rated mean score 5.8, where everyone strongly agreed that it is sole responsibility of every one to combat climate change. Further, qualitative findings revealed "to fight against climate change is one's own responsibility" (Teacher 9).

Teacher 10 and 2 shared the same perception that climate change is caused by human activities which is supported by the findings in quantitative data where the item "all the human activities are responsible for the climate change issues" is rated very high with a mean score 5.4.

Table 6: Students' perception on climate change

Items	Mean	SD
Climate change is a global threat.	5.0	1.0
Climate change is global concern caused by the developed nations.	4.9	1.1
All the human activities are responsible for the climate change issues.	5.0	1.7
Problems and impacts of climate change are underestimated in the news.	4.3	1.2
Climate change is real.	5.5	0.8
It is late to combat climate change.	3.6	1.4
Each one of us can contribute in combating climate change issues.	4.9	1.0
Climate change is bound to happen because of industrialization.	5.3	0.8
I am responsible for promoting a greener environment to combat climate concerns.	5.1	1.0
Total	**4.7**	**1.1**

Overall mean score of students' perception on climate change awareness is rated high (M=4.7, SD=1.1). The highest rated mean from the item is "the climate change is real " (M=5.5, SD=0.8) which indicated climate change is happening. The item "It is late to combat climate change" is rated lowest (M=3.6, SD=1.4) which showed it is not too late to combat climate change.

Majority of the FGs perceived that climate change awareness means having knowledge about climate change. They also stated that having awareness on climate change would help them change their actions. FG5 perceived that there is change in climate in their community and there is an increase in temperature every year. Similarly, FG 7 and 9 stated "We hear of lots of landslides that are occurring in road sides due to heavy rain."

FG 2 and 11 shared that climate change awareness knows about the causes and effects of climate change. FG 1 and 6 shared that greenhouse gas is the single most human factor that causes climate change. FG 4 were of the opinion that if people are aware of climate change they will try to refrain from doing harmful activities which would contribute to climate change. FG 6 believed that

If they are aware at the school level they would try to play a small role in school level by not burning plastics, reduce production of waste, dump waste in the proper place and keep their community clean so that they are not adding fuel to climate change

Assessing the perception of the teachers and students on climate change awareness in the middle secondary schools of Trashigang Dzongkhag, the study found out that the awareness on the subject varied from school to school. However, the majority of the participants perceived that climate change knows about the causes of climate change like pollution of the atmosphere, effects of climate change, emission of carbon dioxide, and global warming. The quantitative data analysis also revealed that the majority of the teachers have a correct understanding of climate change-induced risks, but only a few teachers have deeper scientific knowledge and understanding of climate change risks. These findings align with that of Link (2015), who conducted research in Denmark on students' perception of climate change and identified notable differences between participants across different schools and of different ages. However, the findings contradict Edo and Osuji (2012) study, which found that teachers are not quite knowledgeable of the causes of climate change. The difference is substantial, and one of the possible reasons is that they utilized a different sample size than the current study. They included not only Geography teachers but also other teachers in their research.

The findings revealed that teachers perceive climate change as a problem of human origin. But they agreed that it can be changed by incorporating educational programs related to climate change in the curriculum. These findings are in line with Mitchill (2015), where the authors revealed that greenhouse gas is the single most human-induced factor that causes climate change. The findings from similar study by Ursavas and Odabasi (2011), also pointed out that the greenhouse effect was completely an anthropogenic phenomenon rather than a naturally occurring process, and it is something not good for the earth. Further, Lorenzoni et al. (2007) revealed that over 97% of climate scientists accept that recent climate change is the result of human activity. Likewise, the qualitative findings also agree with the quantitative findings. The majority of interview and focus group participants shared that education can play a vital role in curbing climate change issues. They also felt that it is a crucial role of the educators to teach the students about climate change. A similar study by Mbah and Apollo (2021), suggested that teaching should not precisely focus on explaining climate science but also create awareness of the impacts of climate change on humanity and the environment. They further support the qualitative findings, where the study stated that education, especially when focused on children and young people, is a key factor in helping to curb climate change. Therefore, it is found necessary that the educational opportunities focusing on teachers' and students' knowledge, understanding, and awareness, and their role should be studied for the development of better teaching-learning opportunities.

The further analysis of the survey items indicated that teachers perceive climate change as a global issue that requires everyone's attention. The findings indicated that teachers perceive education as an important tool to enhance the adaptive capacity and mitigation skills required for climate change in the students. The findings are inconsistent with Whitmarsh and Capstick(2018), where the results indicated that people are more likely to adopt environmentally responsible behavior when they are informed about the consequences of pollution as the causes of climate change. Similar findings are shared in Ochieng and Koske (2021) that most teachers believe that climate change should be taught in schools to mould students' behavior and prepare everyone for an uncertain future due to climate change. The findings also fit with the findings of Bevins (2020), who found that climate change education is important for teachers and wanted to know more about climate change, so they could inform their students about climate change. Therefore, educators have an opportunity to prepare our learners with the knowledge and skills they will need to combat the impacts and effects of climate change. Climate change education offers young people a chance to develop their knowledge, critical and creative thinking, and problem-solving skills while building their resilience and adaptive capacity to act during a crisis.

On the other hand, some of the student participants shared that they are unaware of climate change and its consequences. It was known that the students are less aware about climate change and climate-related issues. The finding is consistent with Huho (2015), where it was also found that the students are less aware of climate change. According to his study, the number of students taking Geography, where climate content was largely taught, had declined steadily over the years. This is quite different according to the current study, where participants felt that climate change is not discussed separately. However, the findings contradict the findings of Cords (2019), where a study revealed that Finnish children and teens are increasingly

worried about climate change. This may be concluded as children in Finland are aware of climate change while our children are not. This difference is caused because climate education in Finland is included in almost all the subjects unlike in the Bhutanese education system. Similarly, most Kenyans and Philippines are aware of climate changes respectively. Therefore, to tackle climate change and related issues integrating climate education in school curriculum is found necessary.

Teachers and students level of climate change awareness

Table 7: *Teachers' level of awareness on climate change*

Items	Mean	SD
The increase in green-house gasses is caused by human activities.	6.0	0.0
The increase in carbon dioxide causes climate change.	5.9	0.3
Climate change cause rapid snow melting.	5.6	1.0
The rainfall pattern has been changed overtime.	5.7	0.5
Climate change is happening everywhere in the world.	5.8	0.4
Bhutan is more sensitive to climate change.	5.4	0.7
Geography textbooks contain information on climate change.	5.0	0.9
My geography teachers taught/teach me about climate.	5.0	0.8
We receive climate related awareness from daily news	5.3	0.9
I know very well about climate change.	5.0	1.0
My school has disaster plan on climate change.	3.8	1.8
Carbon dioxide is a green-house gas.	5.4	1.1
Greenhouse gas in the atmosphere traps the heat.	5.7	0.6
Deforestation increases carbon dioxide in atmosphere.	5.7	0.8
I am well aware about the climate change in Bhutan.	5.4	0.8
Total	**5.4**	**0.8**

Teachers level of climate change awareness is rated high with mean score (M=5.4, SD=0.8). Where item "the increase in greenhouse gases is caused by human activities" rated very high (M=6.0, SD=0.0) which indicated that greenhouse gas is the single most factor that contributes to climate change. The item "my school has disaster plan on climate change" is rated least with a mean score (M=3.8, SD=1.8) which confirmed the school disaster plan has no component on climate issues.
The qualitative findings reveal sources through which teachers become aware of climate change awareness. Majority of the interview respondents shared that both global and local news channels contributed towards their awareness on climate change. Bhutan Broadcasting Service (BBS) and National Geographic Channel have been impactful in bringing awareness on climate change. Teacher 1 shared that, "Whenever there is a show on glacial lake outburst and its mitigation, I don't miss the show". In addition, articles in newspapers have also equally contributed to their awareness level. Teacher 10 shared that "most of the time I watch National Geographic Channel where there is broadcast of the causes and effects of climate change and global warming". Further, respondents also mentioned other media like Facebook and YouTube as the sources for creating awareness. Teacher 5 shared that most of the time "When I prepare lessons for my students I use YouTube for the additional information".

Table 8: Independent sample t test for gender of the teachers and their level of climate change awareness

Level of awareness	F	Sig.	t	df	Sig. (2-tailed)

Equal variances assumed	0	0.668	0.3	14	0.75
Equal variances not assumed			0.3	9	0.768

Independent sample t-test was conducted for the gender of the teachers and their level of climate change awareness. The result shows that the variances are not significantly different ($t(14)=0.3, p=0.75$). This indicates that the level of awareness among male and female geography teachers in Trashigang Dzongkhag is the same.

Table 9: *ANOVA between teachers teaching experiences and level of climate change awareness*

	Sum of Squares	df	Mean Square	F	
Between Groups	0.485	3	0.162	0.893	0.473
Within Groups	2.171	12	0.181		
Total	**2.656**	**15**			

One way ANOVA was conducted and found that the variances between the groups was not statistically significant $F(3,12)=0.893, p=0.473$.As one of the teacher interviewees stated that "I had been teaching geography for the last ten years. I don't see any changes in the geography curriculum".

Table 10: *ANOVA for the qualification of the teachers and level of the awareness*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.177	2	0.089	0.465	0.638
Within Groups	2.479	13	0.191		
Total	**2.656**	**15**			

To assess potential differences, one way ANOVA was conducted and the result revealed that it is not statistically significant $F(2,13)=0.465$, $p=0.638$. The result reveals that there is no significant difference in the level of awareness and qualification of the teachers.

Table 11: *Correlation between teachers' level of awareness and geography education*

		Level of awareness	Geography Education
Level of awareness	Pearson Correlation	1	0.571
	Sig. (2-tailed)		.021
	N	16	16
Geography Education	Pearson Correlation	0.571	1
	Sig. (2-tailed)	0.021	
	N	16	16

Pearson correlation was conducted for the level of climate change awareness and geography education. It revealed that there is moderate positive correlation with statistically significant r=.571, n=16,p=0.021. However, qualitative findings reveal there is very little information contained in the textbook which is not enough to provide a complete package of climate change information. According to Teacher 4, "I browse the internet to plan the lessons" and similarly teacher 5 shared that "I visit the library to browse additional information on climate related issues". Similarly Teacher 10 shared that to teach his students and to provide up to date information on climate change, he would read articles and books related to climate change.

Table 12: *Regression between dependent variable level of awareness and independent variable geography education*

Beta Coefficient	R^2	F	P-Value	Hypothesis Supported
.571	.326	6.773	.021	yes

The dependent variable teachers' level of climate change awareness was further regressed to check the strength of correlation with the role of geography education. There is a significant level of teachers' awareness, $F(1,15)=6.773$, $p<0.05$, which indicated that the curriculum plays a significant role in creating climate change awareness among the students. These results clearly direct the positive effects on the level with $R^2= .326$ and depicts that the curriculum has 32.6% of the influence in creating climate change awareness.

Table 13: *Students' level of climate change awareness*

Items	Mean	SD
The increase in green-house gasses is caused by human activities.	5.3	0.9
The increase in carbon dioxide causes climate change.	5.0	1.0
The rainfall pattern has been changed overtime.	4.8	0.9
The global temperatures have changed compared to the previous decade.	5.0	1.0
Climate change is happening everywhere in the world.	5.4	0.8
Bhutan is more sensitive to climate change.	4.7	1.0
Geography textbooks contain information on climate change.	5.3	0.9
My geography teachers taught/teach me about climate.	5.5	0.8
We receive climate related awareness from daily news	4.5	1.2
I know very well about climate change.	4.5	0.9
My school has disaster plan on climate change.	4.1	1.3
Carbon dioxide is a green-house gas.	5.0	1.1
Greenhouse gas in the atmosphere traps the heat.	5.1	0.9
Deforestation increases carbon dioxide in atmosphere.	4.9	1.2
I am well aware about the climate change in Bhutan.	4.5	1.0
Climate change is not a national concern but global concern.	4.9	1.2
Total	**4.9**	**1.0**

The overall mean score for the students level of climate change awareness is rated high (M=4.9, SD=1.0). The highest rated from the item is "my geography teachers taught/teach me about climate" with (M=5.5, SD=0.8) and my school has a disaster plan on climate change but is however rated least (M=4.1, SD1.3).
The qualitative findings reveal the reasons for having a high level of climate change awareness. The majority of the students had become aware of climate change through social and mainstream media content. For example, FG 5 shared that, "we watch television, world news, listen to radio, and read newspapers which provide up to date information on climate change and its impacts".

Further, the qualitative findings revealed that ICT and books in the library in the school play an important role in creating awareness on climate change among the students. For instance, FG 3 shared that they read books related to climate change in the library which help them to become more aware about climate change.

Table 14: *One way ANOVA for the Students School and level of climate change awareness*

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	6.85	10	0.685	4.579	0.000
Within Groups	69.867	467	0.15		
Total	**76.717**	**477**			

To assess potential differences one way ANOVA was conducted and the result revealed that it is statistically significant F(10,467)=4.579,p=0.000which indicated there is difference in level of climate change awareness among the middle secondary schools.

Table 15: *Robust test of equality of means and post hoc test for students level of awareness and middle secondary school of Trashigang Dzongkhag.*

Level of awareness	Statistica	df1	df2	Sig.
Brown-Forsythe	4.644	10	402.411	0

Having established that there was a statistically significant difference, further Robust test of equality of mean was conducted and found it is statistically significant F(10,667)=4.644, p=0.000. Gongthung Middle Secondary School, Trashigang Middle Secondary School and Dungtse Central School showed statistically significant results.

Table 16: *One way ANOVA between location of the schools and students level of awareness*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.853	2	0.427	2.671	0.07
Within Groups	75.864	475	0.16		
Total	**76.717**	**477**			

To assess potential differences one way ANOVA was conducted and the result revealed that it is not statistically significant F(2,475)=2.67,p=0.07.Thus it can be concluded that the variance of level of climate change awareness and location of school is homogeneity or not significantly different.

Table 17: *Independent sample t- test for gender of the students and their level of climate change awareness*

		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference
	Equal variances assumed	1.147	0.29	0.325	476	0.745	0.01197
	Equal variances not assumed			0.323	453.57	0.747	0.01197

Independent sample t- test was conducted for the gender of the students and their level of climate change awareness. The result shows that the variances are not statistically significant (t(476)=0.325,p=0.745). It indicated that there is no difference between male and female participants in the level of climate change awareness.
Pearson correlation was conducted for the level of climate awareness and geography education which showed moderate positive correlation between variables, r=0.453, n=478 and relationship is statistically significant (p=0.000).

Table 18: *Correlation between level of climate change awareness and geography education*

		Level of awareness	Geography education
Level of awareness	Pearson Correlation	1	.453**
	Sig. (2-tailed)		0
	N	478	478
Geography education	Pearson Correlation	.453**	1
	Sig. (2-tailed)	0	
	N	478	478

Table 19: *Regression between students level of climate change awareness and geography education*

Beta Coefficient	R^2	F	P-Value	Hypothesis Supported
.405	.163	93.595	0.000	Yes

The dependent variable students' level of the climate change awareness was further regressed to check the strength correlation with the role of geography education. There is a significant level of student awareness, F(1,477)=95.595, p<0.05, which indicated that the curriculum can play a significant role in creating climate change awareness among the students. These results clearly direct the positive effects on the level with R^2= .137 and depicts that the curriculum has 13.7% of the influence on the behavior changes.
Assessing the teachers' and students' level of awareness on climate change, the findings of the study revealed that teachers' and students' level of awareness on climate change was significantly high. The study also found moderate positive relation with existing geography curriculum and students' and teachers' level of climate change awareness indicating existing curriculum raised the level of awareness. However, the qualitative findings revealed that geography education has minimum contribution in creating climate change awareness. Similarly, middle secondary school students and teachers in Hongkong also have demonstrated a high level of awareness on climate change (Pascua & Chang, 2017). Further, Kutheet al. (2019) also found that climate change awareness among the students was high in Bangladesh. The high level of climate change

awareness in those countries is attributed to the strong education system in addressing climate change related issues and those countries are more venerable to climate change. However, Ekpohand Ekpoh (2011) found Kalabar Secondary School teachers in Nigeria with low levels of climate change awareness. The authors attributed this to lack of climate change awareness and also lack of government's support in sensitizing the public on climate change.

Sources through which students and teachers become aware of climate change

The study pointed out that various social media and mainstream media helped in enhancing climate change awareness. This was consistent with a study conducted by Barreda (2018), where the study found that the internet and social media as important channels that enhances their level of climate change awareness. Similarly, Maude (2020) stated that mass media such as radio and television improved students' awareness by regularly broadcasting information on climate change. Further, Dlamini (2016) study in South Africa found that the geography textbook does not contain direct information on climate change. However, he found that mass media plays an important role in influencing teachers' and students' perceptions and understanding on climate change. On the contrary, Melia (2019) stated that information presented through social media is broken, old, misleading, and not scientifically sound which further misinforms the learners. Therefore, it is very important to be very selective while selecting resources from the social media.

Besides textbooks and other climate change awareness sources, it was found that individual personal experiences such as changes in the precipitation and cropping pattern with the change in climate in that particular area have helped them to become aware of climate change. For instance, FGD3 stated, "most of the crop species that used to grow well in their villages are now not growing well and the rainfall pattern has changed over time". Interview participants shared that they experienced snowfall in Saling in the past but no snowfall these days. FalayeandOkwilagya(2016), support that youth's personal experience could provide the impetus to address climate change. They believed that students' personal experience plays an important role in the knowledge building and attitude formation of students.

Role of geography education in creating climate change awareness through curriculum, teaching and learning.

Table 20: *Teachers' perception on role of geography education in creating climate change awareness*

Tem	Mean	SD
The current practices in geography education has provisions to create climate change awareness.	4.8	0.8
The geography curriculum places enough emphasis on climate change issues.	4.3	1.1
Geography curriculum creates space to incorporate teaching strategies that help internalize climate-change awareness	4.4	1.2
Geography curriculum enables better understanding on local and regional climate issues.	5.1	0.9
The geography education explores climate-change issues as a global phenomenon	5.2	0.8
Overall	**4.76**	**0.96**

The teachers' perception on the role of geography education in creating climate change awareness is rated high (M=4.76, SD=.96). The item "The geography education explores climate-change issues as a global phenomenon" has the highest mean score (M=5.2, SD=0.8). This indicates that teachers strongly feel that teaching geography can help in becoming aware of climate change. The findings also revealed that climate change related information in the textbook is adequate as the item "the geography curriculum places enough emphasis on climate change issues" is rated high (M=4.3, SD=1.1).

However, the qualitative findings indicated that the geography curriculum provides very limited information in creating climate change awareness. Majority of the participants revealed that they look for information on climate change from other sources such as social media and other resources in the library.

For example, Teacher 5 shared that:
The textbook contains only the basic information on climate change such as negative effects of climate change and about the vulnerability of climate change. However, it is our responsibility to consciously impart and enhance the students' knowledge on climate change. I make sure that the students get enough information on climate change through the activities that I provide to the students.

Further Teacher 2 shared that limited topics in the textbook and less activities have hampered in imparting climate related issues to the students.

Table 21: *Students' perception on role of geography education in creating climate change awareness*

Items	Mean	SD
Geography education has provision to create climate change awareness.	5	0.9
Geography education covers a range of climate change topics.	5	0.9
Geography education educates climate-change issues as a global phenomenon.	5	2
Geography education can help me to become aware of climate change issues.	5.2	0.8
Geography education can help me adopt sustainable behaviours.	4.9	1
Geography education can help me further promote climate change awareness.	5.1	0.9
Geography education can help me be up to date with climate change issues	4.7	1
Overall	**4.96**	**1.03**

The mean score on students' perception of the role of geography education in creating climate change awareness (M=4.96, and SD=1.03), indicating a high level of agreement by the respondents. Item "Geography education can help me to become aware of climate change issues" has the highest mean with 5.1 and item "Geography education can help me be up to date with climate change issues." is rated lowest mean with 4.7.

The quantitative findings revealed how students become aware of climate change awareness through learning geography education despite limited information. FG 2 and 11 shared that there are only two topics on climate change included in geography in Class IX and X. However, FG 10 and 3 revealed that they get less information from textbooks; however, they get ample information on climate change with the help of their teachers through extra activities related to climate change.

The quantitative data analysis revealed that geography education promotes students' and teachers' awareness on climate change. However, the qualitative findings revealed that the information contained in the geography textbook is very limited and not enough to disseminate the factual information on climate change to the students. The findings of the study is similar to Kariuki (2017),where curricula of most developing countries, especially in Africa, show a critical shortage of climate change content at all educational levels from primary to tertiary levels. Therefore, the researcher felt the need for inclusion of explicit topics related to climate change in geography textbooks. This is because education has ripple effects beyond the individual learner, helping to foster greater concern for the environment among family members and helping wider communities to reduce their vulnerabilities to a changing climate.

The study found that teachers consciously impart and enhance the students' knowledge on climate change. For instance, some teachers shared that they give the highest priority to climate change to assure the proper understanding of the content among their students while teaching. This is further confirmed by qualitative findings where the majority of the teacher participants revealed that they explore additional resources to teach about climate change due to limited information in the textbook. Most of the participants suggest that it is very important to prepare a lesson in such a way that it has room for teachers to address the pressing issues of climate change. The findings of Lindell (2012), also argue that simply adding

climate change to the existing curriculum is not sufficient for teachers or students. It was clear that teachers should play an extra role in helping the students better understand climate change events. Similar findings were also indicated in Nation (2017), that curriculum had resulting impacts on the teachers' instruction and student outcomes. Teachers need to adopt effective pedagogical practices to deliver the content effectively. Thus, the teachers play significant role in enhancing the climate change awareness among the students. So, it is vital for the teachers to explore beyond the text to meet the demands of the time.

Table 22: *Teachers' perception on role of geography education in creating climate change awareness through Teaching*

Item	Mean	SD
I am able to create climate change awareness through geography education.	5.3	0.6
Teaching geography has helped me realize the impacts of climate change and share it with my students.	5.6	0.5
Teaching geography has helped me promote climate change awareness.	5.4	0.7
Teaching geography has helped me update my knowledge on climate change and teach it to my students.	5.4	0.6
Overall	**5.30**	**0.72**

The quantitative findings revealed that teaching geography education helped them to become more aware about climate change (M=5.30, SD=0.72). The item "Teaching geography has helped me realize the impacts of climate change and share it with my students" is rated very high (M=5.6, SD=0.5) and item "I am able to create climate change awareness through geography education." is rated high (M=5.3, SD=0.72).

Qualitative findings revealed how teaching geography education enhances climate change awareness. The majority of the teacher participants shared that they explore additional resources to teach about climate change due to limited information in the textbook. Teachers 5 and 10 shared the same view that they provide information on climate change through videos which show the impacts of melting of the ice and rising of the sea level. In addition, teacher 7 shared that videos on migration of the animals and extension of plants grown in different regions were also used as teaching aids.

Some of the respondents shared that

> When climate change issues are introduced in the classrooms while delivering lessons, the students become aware of the ongoing global climate change and they can think about ways on their part to combat climate change.

Table 23: *Role of geography education in promoting climate change awareness through learning*

Items	Mean	SD
Student's learning activities promotes climate change knowledge.	5.1	0.9
Geography project works helps me enhance my climate change awareness.	4.7	1
Any assigned tasks in geography classes helps me to strengthen my climate change awareness.	4.5	1
Discussions in the class has help me realize about climate change awareness.	4.8	1

Preparing for geography exams helps me reflect and remember consequences of climate changes in the human life.	5	1
Overall	**4.76**	**0.98**

Overall mean for this particular theme is 4.76. Students respondents rated highest in "Student's learning activities promotes climate change knowledge" (M=5.1, SD=0.9) followed by lowest in the item "any assigned tasks in geography classes helps me to strengthen my climate change awareness" (M=4.1, SD=1).

Majority of the participants responded that use of the ICT, working on assignment and project work enhance the level of climate change awareness. FG3 and 7 shared that they become aware of climate change through watching videos that are being shown by teachers after which they are assigned to write their reflection on it.

Further, FG 5 stated:

> By doing assignments, project work and home work, they get to explore more by using ICT. Moreover, their teacher encourages them to focus on the currency of the information. They also shared that they are encouraged to include related pictures and information in their work.

The item "geography project works helps me enhance my climate change awareness" has the highest mean score (M=4.7, SD=1) supporting qualitative findings.FG 6 shared that teachers help them to become aware of climate change by

> Providing valid sources of the information and links while doing assignment. The teacher also shows them the documentary and videos related to climate change. Even during the class presentation teachers encourage them to browse and prepare slideshows for the presentation on climate related topics and issues.

The study found that teaching and learning geography helped students and teachers to enhance their awareness on climate change. The study participants shared that teachers teach geography through the use of ICT. One of the students shared that their teachers show videos related to climate change and use ICT to enhance their climate change awareness. The study of Fu (2013) relates that the use of ICT like videos, text, and images such as graphs, diagrams, or pictures can be exchanged along with voice messages has enhanced the awareness of climate change in Singapore students. Teacherinterviewees5 and 10shared the same view that they provide information on climate change through videos that show the impacts of melting of the ice and rising sea level. Fauvilleet al. (2018) stated that the use of ICT inside the classroom offers a potential alternative to field trips and outdoor learning experiences. Specifically, these programs can provide access to places at times when they are otherwise inaccessible. He further elaborated that ICT can also potentially help teachers teach climate topics that are abstract or distant from students' everyday lives. In this way, it will help students to enhance awareness on climate change.

The qualitative findings revealed that students learn more about climate change when they get to do assignments and research. For instance, FG 11 shared that teachers used to provide them with project works and homework on the topic of climate change. While doing it, it helps us to promote awareness on climate change. The study of Rocha et al. (2020) highlighted that classroom exercises like homework and assignment had enhanced climate change awareness among students of Uganda. The study is also in line with Erhabor and Don (2016), where Canadian students are benefited out of classroom activities like homework, debate, and assignments that helped them in enhancing climate change awareness. So, the teachers' need to design the activities, assignments and project works addressing the current climate change issues to disseminate the information to the students.

Challenges in Creating Climate Change Awareness through Geography Education

Table 24: *Challenges of creating climate-change awareness through geography education*

Items	Mean	SD
Geography curriculum does not contain activities that I can impart knowledge on climate change awareness to students	3.2	1.6
I find difficult to embed climate change awareness in my lessons.	3.2	1.4
School lacks resources to carry out climate related experiments that can provide students hands on experience.	4.3	1.6

Limited knowledge on climate-related issues hampers in organizing climate change awareness programmes and campaign.	3.9	1.5
There is limited time to discuss the climate change issues beyond the curriculum demands.	4.3	1.6
Exam oriented curriculum practice ignores the use of fieldwork approaches to learn climate change.	4.3	1.5
Imparting climate change awareness demands versatile teaching skills and pedagogy.	4.2	1.6
Total	**4**	**1.5**

The total mean score for the theme challenges in creating climate change awareness through geography education is 4. This indicates that there are numerous challenges in creating climate change awareness through geography education. The item "School lacks resources to carry out climate related experiments that can provide students hands on experience" "Exam oriented curriculum practice ignores the use of fieldwork approaches to learn climate change" and "There is limited time to discuss the climate change issues beyond the curriculum demands" rated highest (M=4.3, SD=1.6). The item "I find difficult to embed climate change awareness in my lessons" is rated lowest with (M=4.3, S.D=1.4).

The qualitative data revealed that lack of resources is one of the main challenges in enhancing climate awareness. Teachers 1 and 9 shared that poor internet connectivity, lack of geography lab and lack of finance for field trips hinders in imparting climate change education. Teacher 8 shared that "though we have access to the internet but there are lots of fluctuation as a result we are not able to download resources available".

Teacher 3 said that, "We do not have a geographic information system (GIS) and remote sensing (RS) in school to show students about the changes taking place on earth due to climate change. Moreover, we are not well trained in GIS and RS".

Teachers 4 and 8 shared that they are given only three periods with 40 minutes which is very less to focus on global issues like climate change. Teacher 6 further confirmed that "I am not able to take students beyond the classroom due to limited time".

Teachers 5 and 11 also mentioned that too much dependence on examinations to assess students' performance hindered their ability to incorporate other issues apart from what is prescribed by the curriculum. Teacher 2 shared that there is no connection between climate content in different key stages. The ideas in one key stage stand in isolation to another key stage (Teacher 5).

The quantitative findings revealed that lack of resources is one of the main challenges in creating awareness on climate change. Maarouf (2013) also found that the lack of physical facilities and software (GIS and RS) in the schools is the main barrier in effective climate change communication in the classrooms. Thunberg (2019) pointed out that both teachers and students need to have good knowledge of GIS and RS so that they will be able to locate climate-affected areas.

The study also found that exam-oriented curriculum, limited teaching period, teachers' workload and time constraints, are barriers in focusing on topical issues at the time. The findings are supported by the literature. For instance, Subedi (2016) revealed that the mark-oriented education system in Nepal is a barrier in imparting climate change education. Similarly, Link (2013) also reported that limited teaching time in the class obstructs the time they devote to climate change related content. Crayne (2015) also added that resource deficits prevent teachers from focusing more on climate change issues. As suggested by the current study, there is also a need to increase the weighting for climate related topics in the current geography curriculum to ensure better focus from both students and teachers on climate related topics.

Even though Ajuanget al. (2016) reported that students will be well informed if climate change concepts were introduced in all levels of formal education, the study found that there is less information on climate studies included in lower grades and there is less connection on climate change between key stages. Therefore one respondent shared that more climate education should be included in the lower grades with good progression in every key stage.

Teachers' and students' perception on impacts of different teaching strategies in enhancing climate change awareness in students

Majority of the participants stated that teaching itself is not enough; they felt that the inclusion of practical based teaching is needed. Teacher 2 supports a similar view that students will learn more when they are made to be involved in project based

learning. Teacher 4 and 11 shared that field study encourage students to change their attitude and behavior towards environment.

Use of technology in the class helps to enhance climate change awareness as Teacher 10 shared that "by citing relevant examples that are undergoing in other parts of the world through pictorial or video aids".

Majority of the FGs stated that their teachers most often use teaching strategies such as: field work, use of technology, project based learning and inquiry method to address climate change issues. FG 1 shared that "teachers use to help in designing project models on climate change where it helps in creating climate change awareness.

Screening videos in the class has helped to enhance climate change awareness (FG 3). FG 8 and 11 shared that when teachers conduct essay writing, poster competition and debate competition in the class they become aware of climate change. FG 10 was of the view that they are able to understand the reality of the change through excursion programs like visiting water sources, observing vegetation patterns and asking parents about how the growing pattern has changed.

The study revealed various teaching and learning strategies to make students aware of climate change are field visits, project-based learning, and designing a poster. The majority of the teachers and students shared that field visits through observations and practical work helps the students learn better about climate change. This was evident in a study conducted by Spiropoulos (2020) who found that conducting a field study on climate change enhanced students' knowledge related to the same and they could articulate the local impacts of climate change. Further, Shirazi (2009) stated that field observation like change in rainfall pattern, cropping pattern, and migration of the animals helped both teachers and students be aware of climate change. Thus, the field-based study enables students to localize the issue of climate change, allowing for a deeper emotional connection and engagement to the issue, beyond the classroom experience. However, the study by Yli-Panula et al. (2020) argued that an expanded learning climate beyond the classroom was not seen as an important feature of teaching methods. The occurrence of the dissimilarities could be caused due to the differences in a social context and climate literacy of the sample population under study. As evident from the current study, students likely require more practical based teaching to combat climate change issues and enhance awareness on climate change despite the challenges faced by the teachers in the schools.

The study revealed that engaging students in project-based learning related to climate change had enhanced students' level of awareness on climate change. Wroblewska and Okraszewska (2020) revealed similar findings that project-based learning had a significantly greater effect than traditional learning. The study is also in line with Winthrop and Kwuak (2020) who noticed that students got motivated to know more about climate change after participating in several projects. This indicated that project-based learning provides an opportunity to the students to practically apply their knowledge which helps them in promoting climate change awareness and advocating for people on climate change.

Another strategy as shared by the participants was designing posters on climate change. Participants felt that designing posters were effective in promoting climate awareness among students. This was supported by Whitmarsh and Capstick (2018) who stated that poster is a useful tool to communicate messages, as it does not require a large audience. However, the finding is in contrast with Sun et al. (2021) found out educational posters did not increase students' support or involvement in Climate Change, which illustrates that visualization of information did not increase participants' engagement in climate change actions either. Their study involved both geography and non-geography students. On the contrary, the current study involved only geography students.

Behavioral changes in Teachers and students after teaching geography education

Majority of the teachers interviewees shared teaching geography in schools has brought a change in teachers' attitude leading to change in their behaviour. Teachers 5 and 6 shared a similar view that they prefer to walk rather than drive a shorter distance due to their awareness on climate change. Teacher 4 shared that instead of carrying plastic bags, they carry their own shopping bags. Teachers 9 and 10 share that they have minimized their waste productions and have stopped burning their wastes. They even segregate solid wastes and always dump the wastes in the proper location.

Teacher 3 and 7 mentioned that they inform the public about the negative impacts of climate change and tries to encourage people to go for sustainable living. Teacher 8 shared that after enhancing his climate literacy, he has become more aware of his own actions.

Table 25: *Students Behaviour changes after learning geography*

Items	Mean	SD
I prefer using organic products over inorganic products.	4.9	1.0
I have reduced the amount of water usage.	4.4	1.2
I encouraged my friends to use eco-friendly products.	4.6	1.6
I switch off the light when not in use.	5.4	0.9
I buy products that are eco-friendly.	4.5	1.0
I discourage harming forested areas in my community.	4.8	1.1
I prefer travelling by public transports than in private cars.	4.3	1.4
I reuse and reduce wastes to tackle climate change.	4.6	1.1
Total	**4.7**	**1.2**

The mean score on students' behaviour changes due to climate change awareness is (M=4.7, SD=1.2). Item " I switch off the light when not in use" has the highest mean of 5.4 and item "I prefer travelling by public transports than in private cars" with lowest mean of 4.3. It indicates that students always switch off the light when not in use and frequently travel by public transport.

Majority of the student respondents shared:

> They always dispose of their waste in the proper allocated area. During school events, they encourage themselves to plant trees; even during club activities such as the UNESCO club, they plant trees. They also observe the important international environment days and plant trees during such occasions.

FG 11 shared that

> We used to consume a lot of junk food, but now we have reduced the consumption of junk food by a lot and would always dispose of the wastes in the proper place. Some other examples of mindful actions done by the respondents are that they stopped cutting trees and burning plastics, and they also use the water carefully and always turn the taps off if not in use, they recycle wastes instead of burning.

FG10 and FG5 shared that they have taken up the responsibility to educate the illiterate and to tell them to be aware and mindful about their own actions that contribute towards climate change. FG 8 further confirmed that cleaning campaigns are organized to segregate waste of the school and the community.

Table 26: *One way ANOVA and post hoc test between behavior changes and Middle Secondary Schools in Trashigang Dzongkhag.*

Behaviour changes	Statistical	df1	df2	Sig.
Brown-Forsythe	2.534	10	445.675	0.006

To assess potential differences one way ANOVA was conducted and the result revealed that it is statistically significant F(10, 467)=2.418,p=0.008. Robust test of equality of means was carried out and found Jigmesherubling Central School and Trahigang Middle Secondary School had significant differences.

Table 27: *One way ANOVA and independent sample t test for the students gender and their behavior changes*

Behaviour changes	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	8.189	0.004	-2.414	476	0.016
Equal variances not assumed			-2.372	415.045	0.018

One way ANOVA was conducted as the result revealed that there is statistically significant F(1,476)=0.5.829,p=0.016**.** Independent sample t- test was conducted for the gender of the students and their behavior changes. The result shows that the variances are statistically significant (t(476)=8.189,p=0.004).

Table 28: *Sample t-test for class IX and X and its behavior changes*

Behaviour changes	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	0	0.994	3.867	476	0
Equal variances not assumed			3.87	475.542	0

One way ANOVA was conducted between grade of the students and behavior changes and the result revealed that it is statistically significant F(1,476)=14.955,p=0.000. Independent sample t-test was conducted for the gender of the students and their behavior changes. The result shows that the variances are statically significant (t(476)=0,p=0.000). It could be anticipated that grade 10 learners would perceive and understand climate change differently within the context of their age cohort as a result of different locational contexts.

Table 29: *Correlation between level of awareness and behavioral change and geography education*

		Geography Education	Behavioral changes
Geography Education	Pearson Correlation	1	.453**
	Sig. (2-tailed)		0
	N	478	478
Behavioral changes	Pearson Correlation	.453**	1
	Sig. (2-tailed)	0	
	N	478	478

Pearson correlation was conducted for curriculum and behavior changes has moderate positive correlation between variables, r=0.371, n=478 and relationship is statistically significant (p=0.000). Which indicated that geography education has vital role in shaping students behaviours.

Table 30: *Regression between behavioral change and geography education*

Beta Coefficient	R^2	F	P-Value	Hypothesis Supported
.370	.137	75.314	0.000	Yes

The dependent variable behavior changes were further regressed to check the strength correlation with the role of geography education. There are significant predicted behavior changes, $F(1,477)=75.599$, $p<0.05$, which indicates that the curriculum can play a significant role in shaping students behavior. These results clearly direct the positive effects of the students' behavior with $R^2= .137$ depicts that the curriculum has 13.7% of the influence on the behavior changes.

The findings of the study revealed that there was a change in teachers' and students' behavior after studying climate change in geography. There was moderate positive correlation between students behaviour and geography education. Independent sample t-test revealed that grade X students have more behavioural changes than grade IX. For instance, the majority of the teachers shared that they carry their carry bags while going shopping. Students also mentioned that they put off the light and water tap after using it. The study also found that teachers and students segregate solid wastes and always dump the wastes in the proper place. These behaviors are attributed to climate change and adaptation. Yaldirim and Akar (2021) also highlighted the students became mindful of their own action after studying geography.Similarly, Rocha et al. (2020) exhibited that climate change education has brought climate-friendly behavior to the students. Moreover, Wamsler (2019) also asserted that mindfulness has the potential to contribute to facilitating climate adaptation at all scales, from the individual to the institutional and societal levels.

The study also found that teachers and students can carry out climate change awareness programs in their communities. The majority of the teachers revealed that it is their responsibility to educate the illiterate and to tell them about the consequences of climate change. This was highlighted in a study conducted by Walfisz (2021). He further stated that addressing climate change requires a profound behavioral revolution, which can only be achieved through adequate interdisciplinary and systems-based education. In addition, Lauwrens (2021) also believed that the benefits of children gaining climate awareness can continue at home and encourage the broader community to practice the same habits. For example, after learning to use water sparingly at school, students can practice closing dripping taps at home.

Conclusion

The study found that teachers and students perceive to fight against climate change as the collective responsibility. The participants also felt that it is not too late to act against the climate change. The study found out that the human-induced effects of climate change are on the rise. In general, the climate change awareness is high amongst the middle secondary school teachers and students of Trashigang Dzongkhag. This is mainly because of various social media platforms that played very important role in creating climate change awareness amongst them.

Further the study found that geography textbooks have very limited information on climate change, however, teachers are of the view that they always try to create awareness on climate change despite having limited instructional time. Teachers are also optimistic that teaching about climate change in the classroom will encourage students to act towards combating climate change.

Majority of the teachers' participants suggested teaching strategies such as: inquiry based, activity based, cooperative learning, use of technology and project based learning to be more effective while teaching climate change. There was a moderate positive correlation between role of geography education and students and teachers behavioral changes.

Climate change awareness has become instrumental with the fast-changing world population and living style of the people. Employing the pragmatist paradigm, this study intended to study the role of geography education in creating climate change awareness among middle secondary school teachers and students of Tashigang Dzongkhag. Altogether, 571 participants from 11 middle secondary schools were assessed on their climate change perception, sources, and level of awareness of climate change. Participants were also assessed on the role of geography education, challenges and teaching strategies in creating climate change awareness, and behavioral changes.

The study found out that both the teachers and students have higher level of awareness on climate change. It also revealed that, social media and mainstream media plays an important role in creating climate change awareness. However, the role of textbook on creating climate change awareness was observed very minimal considering much of time spent reading textbook by the students. Despite the importance of climate change awareness, the teachers pointed out that it is difficult to create climate change awareness for the students.

The participants posited that exam-oriented curriculum, limited teaching periods, workloads, time constraints and lack of resources as some of the challenges in creating climate change awareness. However, teachers and students felt that if teaching-learning strategies such as field visits, project-based learning, poster designing, inquiry-based learning and group discussions are incorporated it is likely to help in creating climate change awareness. The findings of the study exhibit the need for collaboration between the stakeholders such as schools, NEC, BES, and REC.

Limitations of the study

This study was conducted in one district of Bhutan. Therefore, the findings do not represent the views of all Bhutanese teachers and students on climate change.

This study lacks literature from Bhutanese context. Though there are studies on climate change conducted in the country, studies on teachers' and students' understanding of climate change was not explored before. Most of the literatures used in this study are borrowed from the context elsewhere and are contextualisedto Bhutanese context. Thus, there may arise a difference in the context and situation of the literatures used in this study.

The qualitative data for this study was collected through telephonic interviews due to Covid-19 pandemic. Owing to the critical situation posed by the pandemic, there was a complete movement restriction to the school campus. This has impacted the face-to-face interview, which otherwise could have provided more opportunities to probe and get better insights on the topic concerned.

The study would have been better if document analysis on geography textbook of Class IX and X were carried out. Analyzing and evaluating the text could have helped in data triangulation and evaluating how textbook contributes to the level of awareness on climate change

Recommendation

The study makes the following recommendations:

The study found that climate change awareness is a concern and should be treated separately. However, Bhutanese geography textbooks do not contain adequate topics on climate change. Therefore, the study recommends Department of Curriculum and Professional Development to include additional chapters or units on climate change with more factual information. Inclusion of more topics will help students to know more from textbooks than from social media.

The study also recommends the concerned agencies such as RSPN, NEC, Green Bhutan and Bhutan Ecological Society (BES) to continue working on creating advocacy and awareness programs in the schools. The continued advocacy program in the schools will help students and teachers to remain updated and aware about climate change.

The Ministry of Education and Dzongkhag Education Office should provide adequate resources such as better ICT facilities, access to internet and teaching learning materials to enhance teaching about climate change awareness through teaching and learning.

Schools and teachers adopt the good practices like waste segregation, strickly prohibiting burning of waste, planting trees in school and community and organize climate change awareness programs. This will enable teachers, students and the community to focus on solutions to combat climate change.

The current study explored the role of geography education on creating climate change awareness. Therefore, the study also recommends the future studies to explore the role of geography education in preparing students for climate change adaptation and mitigation strategies.

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