Journal of Arts and Social Sciences
https://ojs.jass.lcwu.edu.pk

Climate Conscious Youth: A Study of Knowledge, Attitudes, and Practices of Secondary School Students in Lahore

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ARTICLE INFO

Article history:
Submitted 13.09.2025
Accepted 25.11.2025
Published 31.12.2025

Volume No. 12
Issue No. II
ISSN (Online) 2414-8512
ISSN (Print) 2311-293X
DOI:

Keywords: Climate Change, Climate Change in Pakistan, Education on Environment as Climate Change

ABSTRACT

The aim of this study was to measure the knowledge, attitudes, and practices of secondary school students regarding climate change. A cross-sectional research design was used to compare the variables between public and private school students of grade 10. A total of 854 respondents participated in the study. The data was collected through filling of the survey forms adapted to measure the knowledge, attitude and practices of secondary school students. The findings revealed significant knowledge gaps and misconceptions across public and private school students. It was found that public school students demonstrated higher positive attitudes and practices regarding climate change as compared to their private counterparts. However, a weak positive correlation was observed between attitude and practices of the students. The study has implications for curriculum developers to integrate climate focused themes in the curriculum through standardized sources.

Introduction

Large-scale environmental issues that humans are dealing with include resource depletion, biodiversity loss, and climate change. Most people concur that altering human behavior will be necessary to find answers to these issues. There is an attitude-behavior gap because there is a wide range of people who are concerned about environmental issues. Pro-environmental activity occasionally links these concerns, but not always (Lacroix et al., 2019).

One of the most difficult issues that humanity and the environment are currently confronting is climate change. Whether or not human action or natural processes are to blame, climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as how the atmosphere changes over some time decades or longer. Climate change is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as an evolution in the composition of the atmosphere and a climate change brought on by human activity (Khushik, & Diemer, 2018; Salman, et al., 2023). The long-term consequences of industrialization and the world's rapid development are related to climate change. This may have negative effects on people, animals, and plants (Salman, et al., 2023).

The State of the Climate in Asia 2023 report emphasized how important climate change indicators, like sea level rise, glacier retreat, and surface temperature, are happening faster than expected. These changes

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will have a significant impact on the region's economies, communities, and ecosystems (World Metrological Organization, 2024).

Climate change and rising carbon dioxide concentrations have an impact on ecosystems and will continue to do so. Ecosystems will shift due to rapid climate change; some species will benefit while others may become extinct because they cannot relocate or adapt quickly enough. Increased carbon dioxide levels may boost vegetation's productivity and water-use efficiency. Although little is known about how heat affects biological processes, it may cause atmospheric quantities of natural greenhouse gases to rise (IPCC, 1990).

Climate Change in Pakistan

Disasters are common in Pakistan, and the effects of climate change are making them more frequent and severe. The nation finds itself in a unique scenario due to rapid population increase, inadequate urban management, and the non-implementation of different policies. Pakistan's socio-political instability further contributes to its low resilience to the negative effects of climate change. Vulnerability to current disasters is further increased in Pakistan by extreme poverty and a lack of institutional capacity to effectively respond to the impacts of climate change (Rehman et al., 2021).

Pakistan is battling the multifaceted effects of climate-related issues, including increased temperatures, decreasing dew, floods, droughts and production losses (Mujumdar et al., 2020; Nkurunziza et al., 2019; Ghafoor, & Nawaz, 2020; Fahad & Wang 2018). Pakistan is one of the ten nations in the world most impacted by natural catastrophes and climate change. The nation's already hot environment is expected to continue to warm at a rate that is significantly higher than the world average (Eckstein et al., 2021; World Bank Group, 2022, p. 4). The Himalaya, Hindu Kush, and Karakorum (HKHK) glaciers will melt more quickly due to climate change and anthropogenic carbon (BC) deposits. This would alter the flow of the crucial Indus River system and have a major impact on Pakistan's ecology and economy (Mani, Ed., 2021; World Bank Group, 2022, p. 4).

The long-term effects of climate change on development and economic growth have been substantial. Unfortunately, the burden of unfavorable climate change risks falls on economically vulnerable populations, especially when it comes to their livelihoods (Ali, et al, 2019). Climate change is anticipated to have long-term economic effects due to ecosystem degradation, decreased agricultural productivity, extreme weather-related fatalities, and social unrest (Ghafoor, & Nawaz, 2020).

Damage to property, crops, and livestock caused by climate- and weather-related disasters in Pakistan between 1992 and 2021 totaled US$29.3 billion in economic damages (inflation-adjusted to 2021 US dollars), or 11.1 percent of 2020 GDP. The adjusted economic loss from the 2010 flood alone was 4.5% of 2020 GDP. Over time, the full effects of the 2022 monsoon floods on GDP will become apparent, but preliminary estimates show that they will be greater than those of 2010 (World Bank Group, 2022, p. 5; Ghafoor, & Nawaz, 2020).

Pakistan is highly susceptible to floods due to its location in an area that experiences variations in climate events and global warming (Fahad & Wang, 2019; Qasim et al. 2015). Variations in temperature, variations in precipitation, and recurrent occurrences of hazardous events are examples of climatic events (IPCC 2014; Fahad & Wang 2018). Experts think that floods in Pakistan are caused by variations in the monsoon pattern. The intensity and severity of floods in emerging nations are mostly related to changes in the environment and climate (Qasim et al. 2015).

Floods have caused a significant loss of life and property, as well as forced people to leave their homes and insect assaults are some of Pakistan's other climatic occurrences (Fahad & Wang 2018). The changing monsoon and rising temperatures are probably going to pose a serious threat. It is argued that despite global attempts to reduce greenhouse gas emissions, threats from climate change will persist throughout this century (Abbasi, & Nawaz, 2020).

With land use and forestry contributing less than 1% of world GHG emissions, the nation's total GHG emissions were predicted to be 499 million metric tons of carbon dioxide equivalent (MtCO2e). Land use and energy, including agriculture and forestry, are responsible for 46% and 45% of the nation's overall emissions, respectively. Future GHG emissions will become internationally significant unless steps are done to slow the increase rate of emissions, given Pakistan's sizable population, high energy intensity, and growth objectives (World Bank Group, 2022, p. 6,7; Global Historical GHG Emissions, CLIMATEWATCH, 2022).

Pakistan has continued to lag behind in accomplishing the majority of the global objectives, including eliminating polio, providing universal education, and mitigating the effects of climate change, as per the 2015 Paris Agreement (United Nations Framework Convention on Climate Change, 2022; Khushik, & Diemer, 2018). By 2025, Pakistan's labor force will be among the youngest in the world (P. c. o. Pakistan, 2015). It is believed that climate change poses a threat to the nation's sustainability. The country as a whole

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is experiencing its impacts. It is acknowledged that a solution to the climate change problem is urgently needed. It is suggested that creative solutions be used to stop the climate from getting worse (P. c. o. Pakistan, 2015; Khushik, & Diemer, 2018).

Air pollution and climate change are closely related issues because: (i) many times, GHGs and air pollutants are emitted from the same sources, such as residential cooking, industry, electricity generation, transport, agriculture, and waste; and (ii) some substances, like methane, black carbon, and ground-level ozone, are known to contribute to both climate change and the negative effects of air pollution (SLCPs) (International Energy Association (IEA), 2016; National Clean Air Policy (NCAP), 2023).

The Metropolitan City of Lahore, one of Pakistan's fastest-growing cities, is home to over 50% of the world's population, is a significant energy consumer, and generates 70% of greenhouse emissions (Ghafoor & Nawaz, 2020). Lahore experienced ambient PM2.5 values of up to 123 µg m-3 in 2019, which is at least 24 times higher than the WHO Air Quality Guideline. According to the Air Quality Index (AQI) numbers gathered from the Air Now data, Lahore frequently has an AQI of 400 or higher throughout the winter, with many other cities having readings above 150. Air pollution comprises greenhouse gas (GHG) emissions, black carbon, and tropospheric ozone in addition to Short-Lived Climate Pollutants (SLCPs). Cutting these will help meet the climate change goal as stated in the National Climate Change Policy (NCCP) 2021 and have major co-benefits (National Clean Air Policy (NCAP), 2023).

Education on Environment as Climate Change

One of the most effective strategies we have for addressing the main issues affecting the entire world and its inhabitants is education. To operationalize and direct sustainability in education, a number of frameworks have been created (UNESCO, 2017). Pakistan is dedicated to incorporating sustainability into its educational institutions since it is a signatory to these SDGs (Government of Pakistan, 2017). How successfully they incorporate sustainability into their curricula, particularly in their secondary schools, is still mostly unknown (Jamil et al., 2024).

It is crucial to remember that environmental education is not offered as a stand-alone subject in Pakistan. However, elementary and high school science curricula now include environmental education themes like energy, the greenhouse effect, pollution, microorganisms, recycling, and ecosystem (Yousuf & Bhutta, 2012; Rehman et al., 2021; Esa, 2010).

Additionally, some environmental education principles are included in elementary and secondary level Urdu, English, Social Studies, and Islamic Studies textbooks. These concepts are provided as part of the material in different chapters. Very little effort is made to connect ideas, particularly between the environment and science and vice versa (Yousuf & Bhutta, 2012; Rehman et al., 2021; Esa, 2010).

Furthermore, by raising awareness of the significance and implementing preventative measures, teachers serve as the cornerstone of society's educational process and progress. The textbooks don't include instructions on how teachers should teach these ideas to students in order to raise awareness, foster attitudes, interests, and abilities, but also to give them the tools they need to take action to protect the environment and preserve the planet's natural resources (Yousuf & Bhutta, 2012; Rehman et al., 2021; Esa, 2010).

The way that climate change is taught in schools is impacted by a number of haphazard or incorrect ideas that need to be addressed because they might make it more difficult to comprehend the issue and to take the necessary steps to address it. (De Rivas et al., 2024; Kagawa & Selby, 2012).

Two educational responses to current and projected increases in the severity and frequency of hazards are disaster risk reduction and climate change education. Key components of disaster risk reduction education are shown to connect with three aspects of climate change education: comprehension and attention, mitigation, and adaptation. Climate change and disaster risk reduction must be addressed in any educational contribution to a sustainable future (Kagawa & Selby, 2012).

Since students have the power to shape society to be climate change literate, the early years of high school education are crucial (Lopez & Malay, 2019; Rahman et al., 2014).

There is a need to assist nations in incorporating climate change education into their educational systems because, according to the United Nations Educational, Scientific, and Cultural Organization, or UNESCO, education, awareness-raising, and well-informed decision-making are crucial in enhancing communities' capacities for adaptation and mitigation (Lopez & Malay, 2019).

The awareness, actions and behavior of today's secondary school students will be vital in determining the sustainability and resilience of Lahore in the face of climate change.

Objectives of the study

- To assess overall awareness regarding climate change among secondary school students.
- To explore the attitude of secondary school students regarding climate change.
- To investigate the practices of secondary school students regarding climate change.

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- To find out the relationship between attitude and practices of secondary school students regarding climate change.

Research Questions

- To what extent secondary school students demonstrate a general understanding of climate change?
- What sort of attitudes towards climate change are held by secondary school students?
- What are the practices regarding climate change exercised by secondary school students?

Null Hypothesis

- There is no significant correlation between secondary school students' attitudes, and practices regarding climate change.

Methodology

A cross-sectional study was conducted from October 2024 to January 2025 in public and private secondary schools in Lahore, involving 10th grade students. The study was carried out on a sample of 24 conveniently selected schools (12 from public and 12 from private).

Sample Size and Technique

The sample size was calculated considering a 95% confidence level, and a 5% alpha level. Out of the 1,000 students initially targeted, 854 provided complete and usable responses, constituting the final sample for the study with a response rate of 85.4%.

Study Tool

The study employed a questionnaire adapted from Salman et al. (2023), originally designed for youth populations. The instrument consisted of four sections. The first section was related to personal information of the participants whereas, the other three sections consisted of items to assess knowledge, attitudes, and practices regarding climate change. To ensure cultural and linguistic relevance, the questionnaire was translated into Urdu. The items deemed irrelevant to the Pakistani context were excluded, and certain questions were modified to enhance clarity and contextual appropriateness.

The instrument underwent expert validation through a review by three academic professionals to ensure content validity. Additionally, a pilot test was conducted with a small sample group to assess the clarity and reliability of the items. The reliability of the instrument was evaluated using Cronbach's alpha, yielding a coefficient of .764 for the Practices scale and .659 for the Attitude scale, indicating acceptable internal consistency.

Statistical Analysis

The data was analyzed using SPSS version 20. Descriptive statistics were used to summarize the basic demographic information of the research participants. Categorical variables were presented as frequencies and percentages. Inferential statistical tests, including Pearson correlation, cross-tabulation, and multiple response analysis, were used to analyze relationships and differences among variables. The level of statistical significance was set at $p < 0.05$.

Descriptive statistics were used to show the demographic characteristics of the 854 participants. The sample consisted of 46.6% male and 53.4% female students. A majority were from public schools (59.5%), while 40.5% attended private schools. Most students were enrolled in the science stream (82.6%), with a smaller proportion in the arts stream (17.4%). The predominant age groups were 15 years (49.2%) and 16 years (34.0%).

Results

Overall Awareness regarding Climate Change

A total of 854 secondary school students participated in the study. Overall, the majority of respondents (n = 301, 35.2%) rated their understanding of climate change as "Good," suggesting a generally favorable level of awareness across the sample. This showed that in general secondary school students demonstrate a moderate to good understanding of climate change.

The analysis demonstrated that a substantial majority of both public (53.7%) and private (55.8%) secondary school students acknowledged the issue of climate change. Furthermore, over half (54.5%) perceived climate change as an urgent issue necessitating immediate action. Only a small minority (under 5%) regarded it as unimportant or not a priority. Similarly, 53.5% of respondents recognized recent climatic changes, while 36% considered it a gradual process. Just 8% denied any changes in climate, and 2.6% were uncertain.

In terms of causality, nearly 70% of students from both sectors identified human activity as the primary driver of climate change. Though, 16.6% attributed it to natural causes, while 10% believed in a combined influence. However, less than 5% expressed uncertainty regarding the issue.

Students also exhibited awareness of international climate efforts. A significant proportion recognized that the Paris Agreement applies to all countries (59.8% public; 43.4% private), though

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misconceptions persisted. Awareness of Pakistan's specific contribution to climate change was moderate, with 28.9% of public and 31.5% of private school students citing population growth as a major factor.

Notably, the majority of students believed that a CO_2 concentration of 200 ppm posed a significant threat (65.2% public; 75.1% private), indicating a general grasp of atmospheric impacts despite limited historical context knowledge.

General Understanding of Climate Change among Students

The internet and social media emerged as the primary knowledge sources, especially for private school students (67.6% and 62.7%, respectively), compared to public school students (58.7% and 47.2%). Schools and universities also contributed notably (46.1% public; 40.5% private), underscoring the role of formal education in disseminating climate-related information.

- **Carbon Footprint**: Around half of the students were familiar with the term (50.4% public; 50.6% private), while the other half lacked understanding.
- **Greenhouse Gases**: CO_2 was the most recognized gas, followed by CFCs and ozone. However, misconceptions were evident, with some students incorrectly identifying sulfur and lead as greenhouse gases.
- **Blue Carbon Areas**: Coral reefs and seagrasses were more recognized by public school students, while mangroves remained the least understood. The "I don't know" response was higher among private school students (38.9%) than public (17.1%).
- **Climate Agreements and Temperature Increase**: Public school students exhibited greater accuracy in identifying the global temperature increase since the pre-industrial era (59.8% vs. 43.4%) and had fewer "I don't know" responses.
- **Impact Awareness**: Private school students generally showed higher recognition of climate change impacts such as drought (71.7% vs .51.0%), water shortages, sea level rise, and glacier melting.

Awareness of Climate Policies

Public school students were more aware of policy actions like afforestation, waste recycling, and reducing subsidies. In contrast, private school students showed greater awareness of awareness campaigns and renewable energy use but had a higher rate of uncertainty (18.8% "I don't know").

Understanding of Resource Linkages

Both groups showed moderate understanding of the interconnections between water, food, and energy, though recognition was strongest for the water-food link. The overall recognition of the water-food-energy-climate relationship remained low in both groups.

Sustainable Practices and Daily Life

Students showed awareness of how everyday actions relate to climate change:

- **Energy Consumption**: Fridges and air conditioners were widely recognized as high-energy appliances.
- **Distance Learning**: Seen by 39.1% of public and 50.1% of private students as reducing emissions.
- **Dietary Habits**: Red meat consumption was higher among private students, suggesting a greater potential contribution to emissions compared to public school students, who consumed more white meat, fish, and vegetarian food.

SDGs and Climate Education Gaps

Only 15% of students from both groups were aware of the Sustainable Development Goals (SDGs), indicating a substantial knowledge gap. Similarly, private school students had a higher rate of uncertainty in several areas, such as policy knowledge and temperature trends.

Attitudes Toward Climate Change

To explore the attitudes of secondary school students regarding climate change, descriptive statistics were calculated. The results indicate that students reported a moderate to high level of attitude toward climate change. The attitude scores ranged from 1.77 to 4.85, with a mean score of 3.3355 and a standard deviation of .43421 (N = 854). This suggests that, overall, students hold a generally positive attitude toward climate change issues.

Practices Regarding Climate Change

In exploring students' practices toward climate change, descriptive statistics were also analyzed. The results show that the practice scores ranged from 1 to 5, with a mean of 3.4444 and a standard deviation of .52786 (N = 854). These findings reflect that secondary school students tend to engage in moderate to high levels of environmentally responsible practices, indicating an active involvement in climate change mitigation behaviors.

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Table 1. Descriptive Statistics of Attitudes and Practices Regarding Climate Change (N = 854)

Variable	Minimum	Maximum	Mean	Std. Deviation
Attitude	1.77	4.85	3.3355	.43421
Practices	1	5	3.4444	.52786

Correlation Analysis

The study found a significant but weak positive correlation (r = 0.327, p = 0.000) between secondary school students' attitudes and their practices regarding climate change. This indicates that as students' attitudes toward climate change become more positive, their engagement in climate-friendly practices slightly increases. Since the p-value was less than the 0.05 significance level, the result is statistically significant, leading to the rejection of the null hypothesis. Thus, a meaningful relationship exists between students' attitudes and their climate-related practices.

Table 2. Correlation between attitude and practices (N=854)

Variables	r	p
Attitude	.327	.000
Practices	.327	.000

Discussion

The main objective of the study was to assess overall climate change awareness among secondary school students. The findings of the study assessing self-reported knowledge among secondary school students showed that 35.2% of secondary school students rated their understanding of climate change as Good. This pattern aligned with broader findings, as Salman et al. (2023) reported that approximately 34% of overall participants considered their understanding of climate change to be Good. In contrast, Njoku (2016) found that 87% of participants were familiar with the term climate change.

The study revealed that secondary school students had a strong awareness of climate change, with over 95% acknowledging its existence. Among them, approximately 54.5% perceived it as an urgent issue requiring immediate action, while around 40% believed it deserved attention. Similarly, Salman et al. (2023) found that 92% of respondents recognized climate change as a serious issue demanding action, with only a few suggesting it merely warranted some attention. In contrast, Severin and Small (2016) stated that students exhibited a moderate to high level of concern about climate change. Also, De-Rivas, Vilches, & Mayoral. (2024) found that seventy percent of the students surveyed expressed worry and interest in climate change. Likewise, Tuna, Incekara, and Tung (2011) discovered that 89.3% of students were aware of climate change.

Most of the respondents (53.5%) agreed that climate change had happened recently; however, 36% said it was a slow process rather than a significant change. This observation was aligned with studies by Ghafoor and Nawaz (2020) and Adams et al. (2022), who reported changes in the climate, particularly in terms of temperature, in recent years. Adams et al. (2022) further noted the increased occurrences of floods, heavy rainfall, and windstorms, especially between December and March, which corresponded with the survey respondents' observations. Similarly, Qasim et al. (2015) reported changes in the climate, particularly due to the rising number of floods. On the other hand, a contradicting trend was noted in the study by Salman et al. (2023), where about 89.55% of participants thought the climate had altered recently, reflecting broader public awareness of climate change. However, Fawzy et al. (2020) highlighted that a number of climate change mitigation trends had gained significant attention over the past five years.

Nearly 70% of respondents believed that human activity was responsible for climate change, while 16.6% attributed it solely to natural processes, and 9.7% considered other factors as the cause. These findings align with those of Carr, Buggy, and McGlynn (2015), who reported that 87% of respondents thought human factors were responsible for climate change, while 41% believed that other factors also played a role. Similarly, Salman et al. (2023) found that 92% of respondents believed human activity was the primary driver of climate change. De-Rivas, Vilches, and Mayoral (2024) also noted that around 80.5% of students believed that the anthropogenic origin i.e., human activities was the leading cause. In contrast, Oloke et al. (2013) reported that 45.68% of respondents attributed climate change to natural factors, and 25.32% cited other causes.

A significant portion of secondary-school students (44.0%) identified increasing greenhouse gases (GHGs) as the primary cause of climate change, while 41.9% attributed it to the depletion of the ozone layer. Findings of the present study were found aligned to the study of Salman et al. (2023) who found that 73% of participants believed that greenhouse gases were the leading cause. In contrast, Adams et al. (2022) reported that at least 74% of respondents stated that local polluting activities were mostly responsible for climate

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change.

Only 10% of respondents believed that a carbon dioxide concentration of 200 parts per million (ppm) was incorrect, a finding consistent with Salman et al. (2023), who reported that 16% of respondents held the same belief. This finding was also found aligned with the study by Freedman (2024), who noted that in 2023, the global average surface concentration of CO_2 a major contributor to global warming had reached 420 ppm.

The internet and social media were the primary sources of information for secondary school students, with 62.3% relying on the internet and 53.5% on social media. The internet served as the main source (Lopez & Malay, 2019, p. 60; Severin & Small, 2016, p. 83), while social media played a secondary role (Salman et al., 2023, p. 5). Both had significant influence (Carr, Buggy, & McGlynn, 2015, p. 19) on environmental awareness and practices (Shutaleva et al., 2022, p. 15). Deshiana, Sriyanti, and Ismet (2022) found that 75% of the students received information on climate change through social media. Schools and universities remained powerful sources of climate change information (Salman et al., 2023, pp. 5-6; Carr, Buggy, & McGlynn, 2015, p. 19; Lopez & Malay, 2019, p. 60; Severin & Small, 2016, p. 83).

Various sources, including television, radio, newspapers, magazines, family, friends, and environmental associations, played a role in disseminating climate information, though their impact varied. Television and radio accounted for 32.7% of information access, while the combined influence of television, radio, and environmental associations reached 42%. Newspapers, magazines, family, and friends had a lesser role in spreading climate-related knowledge (Salman et al., 2023, p. 6; Lopez & Malay, 2019, p. 60). Despite this, television (Severin & Small, 2016, p. 83) and radio (Lopez & Malay, 2019, p. 60) remained widely used sources, while newspapers and magazines continued to serve as important platforms for information dissemination (Carr, Buggy, & McGlynn, 2015, p. 19). Overall, broadcast media (television and radio), print media (newspapers and magazines), and electronic media (such as the internet) were the primary channels for acquiring climate change information (Oloke et al., 2013, p. 66). Huang, & Yore, (2005) mentioned that media and television were considered major sources of information in both Canada and Taiwan schools' students.

The Sustainable Development Goals (SDGs) were not well known, with only 15% of secondary school students demonstrating awareness. Njoku (2016) reported that 78% of the sampled population had never heard of the term "sustainable development." Similarly, Yuan et al. (2021) found that only 18.75% of respondents were aware of the SDGs. In contrast, Salman et al. (2023) reported that 66% of respondents had knowledge of the SDGs, might possibly due to government initiatives, educational programs, or international partnerships. Regarding carbon footprint awareness, only 50.6% of respondents were familiar with the concept. This is slightly lower than the 63% recognition rate reported by Salman et al. (2023), which may indicate regional or contextual differences in environmental awareness or education among the surveyed groups. Shutaleva et al. (2022) found that respondents who were aware of carbon footprint concepts were more likely to support specific actions, such as using a train instead of air travel, to reduce CO_2 emissions.

Carbon dioxide consistently emerged as the most recognized greenhouse gas across multiple studies. In the current study, 68.2% of respondents identified it correctly, aligning closely with findings by Wadson, Mulenga, and Milupi (2023), who reported a similar 67.2% recognition rate. Salman et al. (2023) observed lower awareness, with just over 30% of participants acknowledging carbon dioxide as a greenhouse gas, while Carr, Buggy, and McGlynn (2015) reported a recognition rate of 49% among students. Chlorofluorocarbons (CFCs) were the second most frequently identified gas in the present study (49.6%), and were also acknowledged by 53% of respondents in Salman et al.'s study, though much lower recognition was noted by Wadson et al. (10.9%) and Carr et al. (31%). Ozone was selected by 43.8% of respondents in the current study, a figure notably higher than the 15.6% reported by Wadson et al. and the 7% reported by Carr et al., suggesting varied awareness depending on the population. Methane was identified by 30.2% of current respondents, exceeding the rates in Wadson et al. (6.3%) and Carr et al. (24%), but aligning with the "over 30%" awareness level noted by Salman et al. Nitrous oxide was recognized by 27.0% in the current study, while Carr et al. reported a significantly lower identification rate of 14%, and it was not explicitly mentioned in the other studies. Water vapor was the least commonly identified greenhouse gas in the current data (17.1%), yet this was still higher than Carr et al.'s finding of 7%, and comparable to Salman et al.'s (29%) a relatively higher figure that indicates some variability in public understanding. Additionally, a portion of respondents across studies misidentified pollutants like sulfur and lead as greenhouse gases, with 13.6% and 7.7% respectively in the current study, and similar misunderstandings noted by Salman et al., underscoring ongoing confusion about the distinction between greenhouse gases and general air pollutants. While these studies focus on public awareness, Bandh et al. (2021) provided a scientific baseline for understanding greenhouse gases by reporting the Global Warming Potential (GWP) of each gas. In their

study, carbon dioxide was used as the baseline (GWP = 1), while methane was shown to be 23 times more potent, and nitrous oxide 296 times more potent underscoring the critical need for accurate public understanding of each gas's environmental impact.

The average increase in Earth's temperature since the pre-industrial era was recognized as 1.1ºC, 1.5ºC, and 2ºC by 12.5%, 15.5%, and 8.0% of respondents, respectively. However, the majority of respondents (23.4%) admitted they did not know the correct figure. According to Tuna, Incekara, and Tunç (2011), the mean score of 2.51 indicated that students had a moderate level of familiarity with the rise in global temperature since the beginning of the Industrial Revolution.

The majority of students (61.35%) in the current study believed that an increase in temperature, drought, and desertification were major impacts of climate change. It is found aligned with the findings from Severin and Small (2016), where respondents observed temperature changes (67.6%) and increased droughts and decreased rainfall (71.3%) as key consequences of climate change. Similarly, Deshiana, Sriyanti, and Ismet (2022) noted that students recognized disasters like droughts as a significant impact. A considerable proportion of students also acknowledged a low level of rainfall (51.70%), which ties with Severin and Small's finding that increased droughts and changes in rainfall patterns were noted by 71.3% of respondents.

The deterioration of public health (44.20%) was another impact highlighted by students, a concern that mirrors Deshiana, Sriyanti, and Ismet's (2022) findings regarding the spread of vector-borne diseases, such as dengue fever and malaria, with 80.4% of respondents agreeing on its occurrence. In line with this, 41.70% of students in the current study recognized the acceleration of glacier melt, an impact that can contribute to rising sea levels, aligning with observations in Deshiana et al.'s study of environmental disasters. Students also reported increased extreme weather events (40.15%), which is comparable to the 52.2% of respondents in Severin and Small's study who observed increased storms and hurricanes as a result of climate change.

The current study also indicated concerns about high food prices (35.40%), with students perceiving this as a consequence of climate change, which is indirectly related to agricultural shifts and extreme weather events noted by both Severin and Small (2016) and Deshiana et al. (2022). Water shortages (30.50%) and loss of biodiversity (30.45%) were also significant concerns for students, with the former linked to increasing temperatures and changes in rainfall, much like the data analyzed by Adams et al. (2022), which highlighted changes in rainfall patterns. Increased dust storms (21.65%), increased energy consumption (21.50%), and an increase in fires (19.05%) were seen as additional impacts, and although these were not specifically addressed in the studies by Severin and Small or Deshiana et al., they are related to the broader environmental changes reported, such as the increase in temperature and extreme weather events.

Finally, only a small percentage (3.50%) of students were unaware of climate change impacts, which contrasts with the general awareness reflected in previous studies, such as Deshiana et al.'s work, where the recognition of environmental changes and their consequences was widespread. The awareness of impacts such as floods, droughts, and the spread of diseases (Deshiana et al., 2022) indicates a growing understanding of the multifaceted nature of climate change.

Another objective of the study aimed to explore the attitudes of secondary school students regarding climate change. It was found that public school students ($M = 43.84$, $SD = 5.63$) exhibited a slightly more positive attitude toward climate change compared to private school students ($M = 42.66$, $SD = 5.60$). This finding aligns with the study by Sah, Bellad, and Angolkar (2015), which revealed a statistically significant difference in students' attitudes towards global warming based on variables such as age, sex, class, and medium of instruction ($p < 0.05$). However, their study found no significant difference in attitudes based on place of residence, religion, or socio-economic status. Comparatively, public school students demonstrated a marginally more favorable outlook on climate issues than their private school counterparts. However, this finding contrasts with the results of Yousuf and Bhutta (2012), who reported that private school students had a more positive attitude ($M = 3.71$, $SD = 0.28$) than government school students ($M = 3.40$, $SD = 0.43$). Also. In contrast, the study conducted by Salman et al. (2023) reported a generally strong and proactive attitude toward climate change among students.

Another objective of the study was to investigate the climate change-related practices of students in secondary schools. The results indicated an average level of climate-related actions. These findings align with those of Deshiana, Sriyanti, and Ismet (2022), who observed a discrepancy between students' environmental intentions and their actual daily behaviors, suggesting that the desire to act in an environmentally friendly manner did not consistently translate into practice. Similarly, Shutaleva et al. (2022) found that while a majority (54%) of respondents believed eco-behavior practices should be universally adopted, many also felt these practices should be carried out independently, and noted that the youth in Ekaterinburg lacked a stable, reproducible system of environmental practices highlighting inconsistency similar to the current study's findings. On the other hand, the study by Salman et al. (2023)

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contrasts with these results, as it reported a positive shift in the frequency of environmentally friendly practices from "sometimes" to "always" with a statistically significant difference ($p = 0.011 < 0.05$), indicating a more consistent adoption of eco-friendly behaviors.

Conclusion

Secondary school students had a moderate level of understanding of the climate change phenomenon, with over 95% acknowledging its existence. Most of them believed that human activities were the main cause of climate change. However, many also held the misconception that ozone layer depletion was a primary cause. This indicated a possible lack of knowledge among students, which could be attributed to gaps in the curriculum, seminars, and other awareness campaigns related to the topic.

The study found that students attending public and private secondary schools differed significantly in their views and behaviors about climate change. Compared to their private school students, learners attending public schools exhibited a little more optimistic outlook and were considerably more involved in climate-related activities. These findings underline the necessity of investigating the fundamental causes of these variations and point to the significance of encouraging climate knowledge and action in all educational areas.

Learners from public and private schools differed statistically significantly in their attitudes and behaviors about climate change, suggesting meaningful disparities in environmental awareness and engagement based on school type. Specifically, students attending public schools reported higher levels of involvement in climate-related practices and expressed slightly more favorable attitudes toward climate change compared to their classmates in private schools. This indicated that public school students may have been more actively participating in environmentally conscious behaviors such as recycling, energy conservation, or advocacy. These differences could have been influenced by varying curricular approaches, access to community-based programs, or emphasis on social and environmental issues within each school setting.

The Pearson correlation coefficient indicated a weak but positive relationship between students' attitudes and their practices. This suggested that as students developed more positive attitudes, such as increased interest, motivation, or perceived value of climate-related subjects, their corresponding behaviors and learning practices tended to improve as well. Although the strength of the relationship was modest, the statistically significant p-value ($p = 0.000$) confirmed that the association was unlikely to be due to chance, lending credibility to the observed pattern. This implied that fostering positive attitudes in students could contribute to better educational practices, though it also highlighted that attitudes were just one of several factors influencing student behavior. Educators and policymakers should, therefore, have considered strategies that enhanced student attitudes as part of a broader approach to improving academic engagement and performance.

Recommendations

- In order to increase awareness regarding climate change, curricular changes were suggested at both public and private school systems' syllabi such as inclusion of courses on climate change, the Sustainable Development Goals (SDGs), carbon footprints, and environmental science.
- Future research may put additional insight on how pupils connect global climate issues into their local environment by concentrating on regional environmental problems like heat waves and smog. Additionally, this can assist to guide the creation of more focused and successful school-based climate education initiatives.
- District govt can make up district-wide or national students advisory committees focused on climate change by providing students the chance to take part in environmental policy discussions and forums hosted by their local government.
- To track changes in students' knowledge, attitudes, and behaviors, climate education observatory can be developed (Develop tools like surveys, quizzes, and observation checklists). More Coordinated approach with academic institutions and non-governmental organizations to conduct long-term research on the efficacy of climate education programs might be beneficial to assess the impact of such efforts.

References

Abbasi, Z. A. K., & Nawaz, A. (2020). Impact of climate change awareness on climate change adaptions and climate change adaptation issues. *Pakistan Journal of Agricultural Research, 33*(3), 619-636. 10.17582/journal.pjar/2020/33.3.619.636

Adams, I., Ghosh, S., Runeson, G., & Shah, M. (2022). Local perceptions and scientific knowledge of climate change: Perspectives of informal dwellers and institutions in Accra, Ghana. *Sustainability, 14*(9), 5080. https://doi.org/10.3390/su14095080

Correspondence concerning this article should be addressed to Kiran Shehzadi, kiran.shahzadi@ue.edu.pk

Ali, S., Sajjad, & Liu, Y., Abdullah, Nazir, A., Ishaq, M., Shah, T., Ye, X., Ilyas, A., Khan, A., Din, I., & Tariq, A. (2019). The effect of climate change on economic growth: Evidence from Pakistan. *Pacific International Journal*, *2*(2), 70. https://doi.org/10.55014/pij.v2i2.70

Bandh, S.A., Shafi, S., Peerzada, M., Rehman, T., Bashir, S., Wani, S. A., & Dar, R. (2021). Multidimensional analysis of global climate change: a review. *Environmental Science and Pollution Research, 28*, 24872–24888. https://doi.org/10.1007/s11356-021-13139-7

Carr, P., Buggy, C. J., & McGlynn, G. (2015). Climate change awareness amongst secondary level students' in a Dar es Salaam University College of Education (DUCE) affiliated school in urban Tanzania. *Proceedings From the ICSD 2015*.

De Rivas, R., Vilches, A., & Mayoral, O. (2024). Secondary School Students' Perceptions and Concerns on Sustainability and Climate Change. *Climate*, *12*(2), 17.

Deshiana, A., Sriyanti, I., & Ismet. (2022). High school students' awareness and attitudes toward climate change. *Berkala Ilmiah Pendidikan Fisika*, *10*(3), 320–330. https://doi.org/10.20527/bipf.v10i3.14001

Eckstein, D., Künzel, V., & Schäfer, L. (2021). *The global climate risk index 2021*. Bonn: Germanwatch.

Esa, N. (2010). Environmental knowledge, attitude and practices of student teachers. *International Research in Geographical and Environmental Education*, *19*(1), 39–50. https://doi.org/10.1080/10382040903545534

Fahad, S., & Wang, J. (2018). Farmers' risk perception, vulnerability, and adaptation to climate change in rural Pakistance. *Land Use Policy*, *79*, 301–309.

Fahad, S., & Wang, J. (2019). Climate change, vulnerability, and its impacts in rural Pakistan: a review. *Environmental Science and Pollution Research, 27, 1334-1338.*

Fawzy, S., Osman, A. I., Doran, J., & Rooney, D. W. (2020). Strategies for mitigation of climate change: a review. *Environmental Chemistry Letters*, *18*, 2069-2094.

Freedman, A. (2024, October 28). Greenhouse gases surged to record levels in 2023. *Energy & Climate.*

Ghafoor, A., & Nawaz, R. (2020). Changes in climatic parameters in metropolitan city of Lahore, Pakistan. *Journal of Environmental and Agricultural Sciences*. *22*(3), 23-33.

Global Historical GHG Emissions, CLIMATEWATCH, (2022). Pakistan | Total including LUCF | Greenhouse Gas (GHG) Emissions | Climate Watch

Huang, H. P., & Yore, L. D. (2005). A comparative study of Canadian and Taiwanese grade 5 children's environmental behaviors, attitudes, concerns, emotional dispositions, and knowledge. *International Journal of Science and Mathematics Education*, *1*, 419-448.

Intergovernmental Panel on Climate Change. (1990). *Climate Change: The IPCC Scientific Assessment* (J.T. Houghton, G.J. Jenkins, & J.J. Ephraums, Eds.). Cambridge University Press.

Intergovernmental Panel on Climate Change. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (Eds.)]. IPCC. https://www.ipcc.ch/site/assets/uploads/2018/02/AR5_SYR_FINAL_full_wcover.pdf

International Energy Association (IEA) (2016), Energy, Climate Change and Environment 2016 Insights, IEA, Paris https://www.iea.org/reports/energy-climate-change-and-environment-2016-insights, Licence: CC BY 4.0

Jamil, M., Mehmood, W., & Aslam, A. (2024). Sustainability education in Pakistan: A qualitative content analysis of the 10th grade Pakistan Studies textbook. *Voyage Journal of Educational Studies*, *4*(2), 80-95. https://doi.org/10.58622/vjes.v4i2.152

Kagawa, F., & Selby, D. (2012). Ready for the Storm: Education for Disaster Risk Reduction and Climate Change Adaptation and Mitigation1. Journal of Education for Sustainable Development, 6(2), 207-217. https://doi.org/10.1177/0973408212475200

Khushik, F., & Diemer, A. (2018). Critical analysis of education policies in Pakistan: A sustainable development perspective. Social Science Learning Education Journal, 3(09), 01-16. https://doi.org/10.15520/sslej.v3i09.2282

Lacroix, K., Gifford, R., & Chen, A. (2019). Developing and validating the Dragons of Inaction Psychological Barriers (DIPB) scale. *Journal of Environmental Psychology*, *63*, 9-18. https://doi.org/10.1016/j.jenvp.2019.03.001

Lopez, J. J. D., & Malay, C. A. (2019). Awareness and attitude towards climate change of selected senior high students in cavite, Philippines. *Asia Pacific Journal of Multidisciplinary Research*, *7*(2 Part III), 56-62.

Mani, M. (Ed.). (2021). *Glaciers of the Himalayas: Climate Change, Black Carbon, and Regional Resilience*

(South Asia Development Forum). World Bank. http://hdl.handle.net/10986/35600.
Mujumdar, M., Bhaskar, P., Ramarao, M. V. S., Uppara, U., Goswami, M., Borgaonkar, H., Chakraborty, S., Ram, S., Mishra, V., Rajeevan, M., & Niyogi, D. (2020). Droughts and Floods. In: Krishnan, R., sSanjay, J., Gnanaseelan, C., Mujumdar, M., Kulkarni, A., & Chakraborty, S. (eds) Assessment of Climate Change over the Indian Region. *Springer, Singapore*, 114-117. https://doi.org/10.1007/978-981-15-4327-2_6.
National Clean Air Policy (NCAP), Ministry of Climate Change Government of Pakistan May 2, 2023.
Njoku, C. (2016). Awareness of climate change and sustainable development issues among junior secondary school (JSS) students in Port Harcourt Metropolis, Nigeria. *International Journal of Curriculum and Instruction*, *8*(2), 29–40
Nkurunziza, I.F., Guirong, T., Ngarukiyimana, J.P., & Sindikubwabo, C. (2019). Influence of the Mascarene High on October-December rainfall and their associated atmospheric circulation anomalies over Rwanda. *Journal of Environmental & Agricultural Sciences*, *20*, 1-20.
Oloke, O. C., Ijasan, K. C., Ogunde, A. O., Amusan, L. M., & Tunji-Olayeni, P. F. (2013). Improving urban residents' awareness of the impact of household activities on climate change in Lagos State, Nigeria. *Journal of Sustainable Development*, *6*(4). https://doi.org/yourDOIhere
PAKISTAN, P. c. o. (2015). Pakistan vision 2025. Islamabad: Planning commission of Pakistan.
Qasim, S., Khan, A.N., Shrestha, R.P., Qasim, M. (2015) .Risk perception of the people in the flood prone Khyber Pakhtunkhwa province of Pakistan. *International Journal of Disaster Risk Reduction*,*14*(4), 373-378.
Rahman, S., Tasmin, S., Uddin, M. K., Islam, M. T., & Sujauddin, M. (2014). Climate Change Awareness among the High School Students: Case Study from a Climate Vulnerable Country. *International Journal of Built Environment and Sustainability*, *1*(1). https://doi.org/10.11113/ijbes.v1.n1.4
Rehman, N., Zhan, W., Khalid, M. S., Iqbal, M., & Mahmood, A. (2021). Assessing the knowledge and attitude of elementary school students towards environmental issues in Rawalpindi. *Present Environment & Sustainable Development*, *15*(1).
Sah, J. K., Bellad, A. A., & Angolkar, M. (2015). *Assessment of the knowledge and attitude regarding global warming among high school students of Ramnagar, Belagavi city: A cross-sectional study*. IOSR Journal of Dental and Medical Sciences, 14(4, Ver. VI), 74–78. https://www.iosrjournals.org
Salman, N., Al-Mannai, M., Abahussain, A., & Alalawi, M. S. M. (2023). Young Students' Knowledge, Attitude and Practice towards Climate Change. *Global Warming*, 157.
Severin, P., & Small, B. J. (2016). Knowledge Attitude, Practices/Behavior (Kap/B) Study On Climate Change. *Saint Lucia Baseline Study*.
Shutaleva, A., Martyushev, N., Nikonova, Z., Savchenko, I., Abramova, S., Lubimova, V., & Novgorodtseva, A. (2021). Environmental behavior of youth and sustainable development. *Sustainability*, *14*(1), 250.
Tuna, F., Incekara, S., and Tung, S. (2011). Measuring high school students' knowledge about climate change: A case study from Istanbul. *World Applied Sciences Journal*, *15*(2), 297-303.
UNESCO. (2017). Education for sustainable development goals: Learning objectives. In: UNESCO Paris, France.
United Nations Framework Convention on Climate Change (UNFCCC). (2022). *Sharm el-Sheikh Implementation Plan* (FCCC/CP/2022/L.19). https://unfccc.int/documents/624444
Wadson, D., Mulenga, I. M., & Milupi, I. (2023). CLIMATE CHANGE EDUCATION IN MALAWI: EXAMINING LEARNERS'KNOWLEDGE, ATTITUDES AND PRACTICES TOWARDS LEARNING CLIMATE CHANGE EDUCATION CONTENT IN SENIOR SECONDARY SCHOOLS. *ZANGO: Zambian Journal of Contemporary Issues*, *37*(2), 67-86.
World Bank Group. (2022). *Pakistan Country Climate and Development Report* (CCDR Series). http://hdl.handle.net/10986/38277
World Metrological Organization, 2024 "The State of the Climate in Asia 2023" State of the Climate in Asia 2023 (wmo.int)
Yousuf, A., & Bhutta, S. (2012). Secondary school students' attitude towards environmental issues in Karachi Pakistan. *Journal of Educational and Social Research*, *2*(10), 154-165.
Yuan, X., Yu, L., & Wu, H. (2021). Awareness of sustainable development goals among students from a Chinese senior high school. *Education Sciences*, *11*(9), 458.