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Climate Change Education at the Primary School Level in Pakistan: A Comparative Analysis of Curricula and Teaching Practices

Abstract

Education about climate change serves as a fundamental requirement for establishing environmental stewardship among primary school students. The investigation compares climate change knowledge between Pakistani public and private primary schools by utilizing UNESCO's climate education framework together with Shulman's Pedagogical Content Knowledge (PCK). The research methodology combined quantitative and qualitative methods to analyze textbooks from the Punjab Textbook Board and Oxford University Press, gather survey data from teachers, and conduct structured interviews followed by statistical assessment. The research shows modest direct climate-related learning appears in both public and private school curricula with private schools achieving better results in teaching methods. The participating sectors demonstrate teaching difficulties because of insufficient training and complex material which strengthens the argument for educational development based on UNESCO principles as well as PCK best practices..

Keywords: Climate Change Education, Unesco Framework, Pedagogical Content Knowledge (Pck), Public and Private Schools Pakistan, Curriculum Analysis, Teacher Perceptions

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Abstract

Education about climate change serves as a fundamental requirement for establishing environmental stewardship among primary school students. The investigation compares climate change knowledge between Pakistani public and private primary schools by utilizing UNESCO's climate education framework together with Shulman's Pedagogical Content Knowledge (PCK). The research methodology combined quantitative and qualitative methods to analyze textbooks from the Punjab Textbook Board and Oxford University Press, gather survey data from teachers, and conduct structured interviews followed by statistical assessment. The research shows modest direct climate-related learning appears in both public and private school curricula with private schools achieving better results in teaching methods. The participating sectors demonstrate teaching difficulties because of insufficient training and complex material which strengthens the argument for educational development based on UNESCO principles as well as PCK best practices.

Keywords:

Climate Change Education, Unesco Framework, Pedagogical Content Knowledge (Pck), Public and Private Schools Pakistan, Curriculum Analysis, Teacher Perceptions

Introduction

Climate change is universally recognized as a pressing global issue, and scientific evidence the need for urgent collective action. There is agreement among climate scientists that the necessity of limiting global temperature increases to below 1.5 °C above pre-industrial levels, a threshold identified as critical for avoiding the most severe environmental disruptions (UNEP, 2022). The results of climate change have extended far beyond environmental degradation, increasingly impacting human health on a global scale. As Scholes & Engelbrecht (2021) emphasize, the

growing body of research into climate-related health risks reflects the heightened awareness of its widespread implications for planetary well-being.

The Intergovernmental Panel on Climate Change (IPCC) further supported its findings, which in its Fifth Assessment Report confirms that human activities have significantly altered the Earth's climate system (IPCC, 2022). These results provide compelling validation for viewing climate change as a human-induced crisis that exceeds regional boundaries. The unfavorable outcomes of the rise in global temperatures, marine acidification, and sea level rise have already resulted in threatened livelihoods worldwide (Khaiwal et al., 2024). In Asia, surface air temperatures have steadily increased since the 20th century, which raises alarms about the socio-economic vulnerabilities of the region (Ren et al., 2023).

Climate change is a shared global responsibility reflected in an agreement called the Paris Agreement an international framework Formulated under the United Nations Framework Convention on Climate Change (UNFCCC), This agreement directs nations to collaborate in minimizing temperature increase by adopting environmental challenges. This approach reinforces the concept of working collectively and makes it a universal commitment (Meinshausen et al., 2022).

The consequences of climate change require mental health implications and immediate attention. Wildfires and floods cause financial instability and forced displacement leads to direct trauma which can manifested through psychological tolls (Liu et al., 2021). Importantly, people who endure climate effects firsthand not only face emotional distress but it is increasingly reported among individuals who experience climate anxiety indirectly or in anticipation of future threats (Clayton & Karazsia, 2020). Within this broader context, to cope with escalating environmental challenges the world is seeking long-term strategies for this the viewpoints of early childhood educators on climate change education are gaining relevance (Borg et al., 2019).

Early childhood is widely considered a basic phase for shaping values and behaviors, making preschool education a crucial site for instilling environmental awareness. In this early stage of emotional, cognitive, and social development, the influence of preschool teachers becomes especially significant. Their ability to guide children's understanding and attitudes toward environmental issues places them at the forefront of fostering climate-conscious behavior from a young age (Beach, 2023).

In summary, the scientific evidence concerning rising global temperatures, and the growing concern over both physical and mental health effects all reinforce the urgent need to treat climate change as a shared global priority.

Pakistan is frequently identified among the most vulnerable to climate-related impact and the stakes are particularly high (Saeed et al., 2024). Environmental disturbances from climate change affect Pakistan's domestic stability along with its ability to prosper sustainably (Raza, 2023). The study of early childhood educators in Karachi emphasizes environmental awareness as a priority because of Pakistan's recurring climate crises (Jan et al., 2020). The urgent situation demands expanded climate education programs which must start from the primary grades of education.

The practical execution of primary school climate change education in Pakistan stands fragmented and poorly researched even though national policies such as the National Climate Change Policy and Single National Curriculum are attracting greater interest (Atta-Ur-Rahman & Shaw, 2015). This research examines educational content delivery approaches between teachers in public and private institutions and student interactive methods with materials (Atif Saeed, 2023; Nadeem & Nawaz, 2023). Many scholars and researchers struggle to understand how climate change information presents itself in primary school textbooks (Batool & Behlol, 2024; Saeed et al., 2024). The research investigates climate change awareness in Pakistani primary school education through comprehensive evaluations of educational content classroom methodologies and student perceptions in diverse educational environments.

The study investigates climate change education progress by analyzing how climate-related themes appear in Pakistan's primary school system. Public schools together with private educational institutions show significant shortcomings in their teaching content and

instructional delivery methods. The research outcomes will guide both curriculum developers and policymakers to recognize problematic areas for reform alongside providing assistance to educators in enhancing their instructional techniques for environmental education. The research seeks to establish environmentally responsible and socially adept youth through its findings.

Literature Review:

Importance of Climate Change Education Globally

The rise of climate change effects worldwide has led to education being increasingly recognized as a vital driving force in the transition toward sustainable societies. Sustainable societies utilize education as their most essential component to achieve this transition. It plays a pivotal role in shaping the attitudes, values, and behaviors necessary to mitigate environmental harm and promote long-term resilience (Trott, 2020). The effectiveness of technical climate solutions depends on successful public education and awareness programs to become operational at the right time. Correct implementation of these strategies shows the potential to lower the social and psychological impact that future generations will face due to climate-related incidents (Augustinavicius et al., 2021).

Climate change education has emerged as a key component of the global response to the climate crisis. Improving climate literacy, particularly among young learners encourages individuals to understand the causes and consequences of global warming and to adopt more sustainable practices in daily life (Jan et al., 2020). Education systems worldwide are being urged to incorporate climate change content across all levels of instruction, with growing attention on early learning environments where foundational values and habits begin to take shape (Atif Saeed, 2023; Jan et al., 2020).

Early childhood education is widely acknowledged as a cornerstone of holistic development. Introducing environmental themes at this stage not only cultivates long-term awareness but also supports the formation of responsible behaviors from a young age (S. M. S., S. B., J. B. R., & I.-T.-Aagahi. Shah, 2023). Moreover, involving children in climate-related learning is seen as both an ethical and practical imperative. Ethically, children have a right to be informed about the challenges that will define their futures. Practically, early engagement prepares them for the responsibilities they will one day assume in shaping climate solutions (Trott, 2020).

In the short term, climate change education plays a pivotal role in cultivating a well-informed public, capable of advocating for and taking action to prevent the most severe consequences of environmental degradation. Looking ahead, it holds the potential to influence societal norms, particularly in high-emission countries, by challenging the unsustainable systems that have become deeply embedded in modern life. Children, in particular, are positioned not only as recipients of knowledge but also as vital contributors to this cultural and environmental transformation (Trott, 2020).

Climate Literacy Integration in School Curricula Across Different Countries

Experts have pointed out the critical need for learning methods that exceed mere information delivery because education holds the potential to alter climate-related threats. Understandably it remains essential to empower students along with children so they become drivers of educational change and capable learning approaches. The current educational approaches often fail to include young children meaningfully in climate discourse discussions which creates a fundamental problem in educational practice (Monroe et al., 2019).

As the climate crisis deepens, education emerges as the base foundation for building societal adaptation and resilience. It facilitates sustainability by equipping individuals with the knowledge and values necessary to minimize environmental harm (Busch et al., 2019). Widespread technical solutions serve as the key factor in successful climate impact mitigation. The success of their solutions depends directly on how well people understand them together with their active involvement, especially among younger generations. The education about climate enables people to develop stronger climate understanding which leads to changes in individual conduct as well as societal values and behavior patterns (Jan et al., 2020).

To achieve this, modifying the existing curriculum is essential. This should prioritize climate literacy, foster critical thinking, and incorporate sustainability principles across educational stages (Clayton et al., 2024). There is growing recognition that climate education must be inclusive of all levels of schooling, beginning in early childhood settings where foundational worldviews are shaped (Atif Saeed, 2023). Early education not only nurtures cognitive development but also supports the formation of sustainable habits and ethical awareness from a young age (Rousell & Cutter-Mackenzie-Knowles, 2020).

Engaging children in climate education is seen both as an ethical imperative and a practical necessity. Ethically, children have the right to understand the environmental challenges that will shape their lives. Practically, early engagement prepares them to assume leadership roles in shaping future climate responses (Trott, 2020). Their inclusion in these conversations reinforces the idea that meaningful climate action must begin with those who will inherit its consequences.

Climate literacy involves the structured inclusion of climate-related learning across educational systems. A person's understanding of the relationship between climate and its impact on societies as well as how human activities affect the climate. Understanding Earth systems principles in combination with data evaluation skills alongside effective communication methods for reaching conclusions (NOAA, 2024).

Education leaders use this approach to merge information about climate into standard teaching structures instead of creating distinct educational programs. Research about early childhood educators in Karachi demonstrated that climate change education needs formal inclusion in Pakistan's national preschool curriculum to engage young children early (Jan et al., 2020).

The climate education system in the United States exists as multiple standalone components. The different states of the United States do not require consistent climate education mandates and this results in insufficient training for teachers and limited resources regarding teaching climate science. Public engagement programs primarily work with adult participants while most structured programs that teach children about climate change remain limited. (Trott, 2020).

Higher education institutions together with high schools use science classes as their main channel to teach climate change topics. The focus on older students often results in younger learners missing early exposure to climate-related topics, which delays critical awareness and action (Wise, 2010).

The study related to climate change education in Australia along with England, Finland, Indonesia, and Israel indicated all nations backed integrating climate-related teaching across multiple curriculum subjects. The importance of this concept is acknowledged by all participants yet each country carried out its implementation differently from others (Ben Zvi Assaraf et al., 2025).

Climate change education serves as an optional teaching subject in Australia which receives variable implementation throughout the curriculum. Education about climate change tends to be implied rather than made compulsory through formal classroom instruction although it depends on teachers' personal interests according to the participants. Presently there is a need for clearer directives to establish uniform integration practices (Dawson et al., 2022). Moreover, the implementation of ocean education faces challenges in Australian schools since their national curriculum already contains a high volume of content material (Aurélio et al., 2021). However, the current revisions have brought greater flexibility to these topics allowing them to merge across different subjects through interdisciplinary methods of instruction. (Freitas et al., 2025). This educational development demonstrates the transportation of environmental instruction throughout established academic fields instead of generating extra subject matter.

The educational institution in England teaches climate change across both Science and Geography program content. Participants identified weaknesses in the program because it focused on too narrow a set of terms and lacked specific targets and teaching standards. Participants expressed concern about inconsistent content delivery because the subject was not well unified

between educators and students across all educational levels (Ben Zvi Assaraf et al., 2025).

Israel together with Indonesia has implemented detailed training programs for climate change education. Years 7 Science students in Indonesia must study climate change education which focuses on environmental effects alongside natural disasters. Introducing a new national curriculum for climate change became the educational policy of Israel in 2022 requiring its inclusion at every grade level from K–12. Climate change education in Years 8 and 10 happens through dedicated instruction and needs official assessment as part of the combined cross-curricular education system. The recent reform solved the disorganized distribution of climate subjects which previously appeared across multiple secondary subjects (Ben Zvi Assaraf et al., 2025; Keshet-Maor, 2022).

National core values in Finland incorporate climate change education which runs throughout the geography and biology curriculum. Schools under Finnish education standards receive extensive freedom to develop their educational strategies. Value-based and multidisciplinary teaching approaches take place within this decentralized system which addresses climate change through collaborative projects. Environmental education follows diverse emphasis levels and teaching depths which depend on the unique take of both the local area and individual educators (Ben Zvi Assaraf et al., 2025).

Numerous other nations besides France and the UK have adopted essential laws and educational policies to teach climate change at all formal education levels. In 2021 Argentina adopted the National Law of Comprehensive Environmental Education to create regulatory standards for national environmental literacy. Italian state schools started requiring climate change instruction in 2019 while dedicating at least one hour per week to teaching this subject (Chang & Pascua, 2017). Earth science content became a part of the upper secondary curriculum in Cambodia for teaching climate concepts. The Singaporean government seeks standardization of climate-themed education through modifications to testing orientation and curriculum structure (Chang & Pascua, 2017). Meanwhile, China has incorporated climate change education into its studies through a comprehensive national reaction to climate change which places educational reform at its core (Han, 2017).

Educators using improper teaching methods create a major hurdle for school-based climate literacy programs to succeed. The education literature endorses learner-centered educational techniques that focus on active learning in real-world contexts. These methods connect environmental subjects to community problems through teaching concepts that involve climate change issues while teaching civic responsibility and emotional aspects (Ben Zvi Assaraf et al., 2025).

The consistent adoption of climate change education experiences several obstacles which hinder its consistent application. Overloaded educational schedules reduce teachers' time and flexibility to teach new subjects including climate change issues (O'Brien et al., 2023). Additionally, a lack of preparedness among educators exists because they lack sufficient content understanding and pedagogical training competence regarding the subject. Because initial teacher education programs lack sufficient formal climate change education educators become responsible for managing complicated material without proper training (Clayton & Karazsia, 2020; Guerrero & Sjöström, 2025).

International educational policies endorse climate education inclusion yet different countries utilize diverse methods for its execution. The difference in climate education outcomes stems from separate national agendas and teaching frameworks and instructor readiness and funding possibilities. Multiple educational delivery methods are evaluated as optimal through ongoing discussions between educational organizations. A different group advocates for subjects that exclusively deal with climate concerns (Freitas et al., 2025).

Climate Change Education in Pakistan

Current rising climate threats against Pakistan emphasize the requirement of developing resilient adaptation methods with effective mitigation plans (Yasin et al., 2021). Educational institutions throughout Pakistan now recognize the importance of teaching climate literacy as part of their educational programs at each level. Various groups of stakeholders demand that climate change education should become part of academic

curricula and extracurricular activities that span from early childhood education to higher education. (Jan et al., 2020). Empirical research conducted in Karachi highlights the importance of introducing environmental concepts during the early stages of learning. It calls for the formal integration of climate change topics into the national preschool curriculum (Saeed et al., 2024). These efforts reflect a national commitment to raising awareness from a young age, preparing students to engage meaningfully with environmental challenges in the years ahead.

Pakistan demonstrated increasing policy engagement with climate issues through formal initiatives. The original National Climate Change Policy (NCCP) of 2012 identified key vulnerabilities, particularly water resources, and aimed to raise awareness among policymakers and researchers about the seriousness of climate change (Yasin et al., 2021). Recently, Pakistan has committed under the Nationally Determined Contributions (NDCs) include the integration of climate change education (CCE) within secondary and tertiary curricula by 2030 (Mbah et al., 2022). The updated NCCP (2021) further emphasizes large-scale public awareness, It proposes community-oriented programs that promote sustainable practices and environmental stewardship (NCCP, 2021). Collectively, these policy measures reflect a growing acknowledgment of education's role in fostering national climate resilience.

Research on climate and sustainability education in Pakistan has primarily focused on higher education institutions (HEIs). A systematic review of sustainability efforts in Pakistani HEIs indicates progress in addressing Sustainable Development Goals (SDGs).

The integration of sustainability principles into quality education continues to present barriers (Hinduja et al., 2023). Academic leaders together with research scholars have been studied regarding their understanding of sustainability while diverse initiatives exist to impart sustainability values to pre-service teachers and university students (Malik et al., 2019).

Climate Change Education (CCE) receives growing interest in Pakistani secondary and higher education institutions but there exists a significant deficiency in its integration at the primary educational level. The incapacity to integrate CCE in primary education is alarming because early education directly influences how children will develop their environmental perception, emotional maturity, and cognitive abilities. There exists limited scholarly research that investigates how the integration of climate change education appears within primary school curricula for young learners (Saeed, 2023).

The research of Saeed et al. (2024) provides concrete instances of structured climate change education for basic education as Karachi preschool teachers demonstrated both the necessity of climate education for young students and teachers' viewpoints on the matter (Saeed et al., 2024). However, educational organizations lack structured research or curricular instruction that details environmental topic integration into early-grade education. A deficiency in the way educational plans are developed indicates a major weakness that needs immediate research and policy advancement.

In conclusion, Pakistan officially supports climate education in its national policies but its primary school sector lacks proper initiatives in spite of its sustained efforts in secondary and tertiary institutions. Eligible early-aged learners must receive environmental knowledge to build resilient climate change communities across long-term timescales.

Curriculum and Textbook Analysis in Pakistan

In Pakistan, textbooks serve as basic educational materials for formal learning institutions to shape student comprehension of various subjects which include environmental and climate matters (Morris & Marsh, 1992). The Punjab Textbook Board (PTB) together with other provincial bodies maintains primary responsibility for textbook development throughout Pakistan. The contents of private schools stem from publications produced by Oxford University Press (OUP) together with other international firms (Afzal et al., 2024). The evaluation of educational materials serves to determine which aspects of climate change education reach young students and which specific messaging they receive.

Formal education plays a crucial role in student environmental awareness education and the development of student sustainability behaviors and mindsets (Lan Curdt-Christiansen & Huang, 2020). According to Zahoor and Janjua (2020), Pakistan shows increasing signs that ecological instructions should be incorporated into school teaching materials. However, reviews of current textbook content reveal significant shortcomings. The English textbooks used at the primary level present a primary vision that establishes an anthropocentric worldview and humans as dominant over nature while lacking eco-centric views. The story encompasses a message that supports human control of natural systems instead of fostering sustainable human-environment interactions (Zahoor & Janjua, 2020).

The research data confirms Pakistan needs improved education about sustainability since its current content does not provide sufficient coverage. The extensive climate exposure of Pakistan fails to appear in its outdated educational material which lacks comprehensive climate-related educational information throughout its educational system. An evaluation of essential curricular design elements becomes necessary to create basic climate literacy at primary education levels.

Secondary educational texts from the Punjab Textbook Board (PTB) and Oxford Progressive English (OPE) display contrasting approaches to environment theme presentation at the middle school level. The Punjab Textbook Board books present human superiority in resource management yet OPE materials use ecological terminology in their publications. The OPE materials establish a relational perspective that connects people to animals in their presentation (Afzal et al., 2024). The findings from secondary texts generate vital questions about how primary-level content related to the environment should be presented. The available direct data in this field is minimal.

Studies about textbooks developed by PTB show recurring human-centered perspectives. The systematic organization within textbooks presents unsustainable activities in an untroubled fashion that fails to include environmental harm details. Offers in textbooks show pollution origins linked to human activities using broad statements while omitting details about institutions that should detect pollution creation. Human beings play an essential role in anthropocentric environmental discourse despite failing to recognize how eco-centric values prioritize animal and plant life (W. A. Shah et al., 2025; Zahoor & Janjua, 2020). The particular formats introduce problems in student comprehension of environmental connections while affecting their developing sustainability perceptions in their early childhood years. Textbooks confuse students about ecological disaster causes because they fail to specifically name policies together with manufacturing operations as key factors. The textbooks analyze responsibility attribution in unclear ways by assigning responsibility either to local communities or by showing a lack of focused responsibility (Stibbe, 2004).

Teachers and administrators in Pakistan criticize the Single National Curriculum (SNC) because it provides limited information about environmental education. The Single National Curriculum comes under criticism because its climate education lacks the appropriate levels required for solving Pakistan's deteriorating environmental problems (Afzal et al., 2024; Aziz, 2023). The SNC textbook development under the nationwide curriculum shows a fundamental weakness in preparing primary school students for effective climate awareness because it fails to build their understanding and analytical abilities.

Research attention to climate change education (CCE) remains scarce within primary education because of insufficient textbook designs and contents used at this academic level. Early-grade educational materials suffer from erratic climate content because policymakers have not clarified directions and scholars have failed to achieve adequate research on climate education. Primary school textbooks typically emphasize simplification and normative content so the anthropocentric elements might dominate alongside systemic environmental neglect because of the foundational stage of primary education (Afzal et al., 2024).

In summary, the evaluation of Pakistani curricula and textbooks demonstrates a human-disciplinary priority while showing weak integration of sustainability and climate-related topics. Research on how environmental themes are taught in early education through PTB and OUP

primary textbooks remains scarce yet the discovered patterns in higher education levels show concerning results. Additional studies together with curriculum adjustments are necessary to guarantee that primary-level educational materials follow both national and global sustainability development and climate literacy targets.

Theoretical Framework

The chosen theoretical framework enables researchers to evaluate how climate change education appears within Pakistan's primary education curriculum. The selected theories enable researchers to evaluate curriculum materials and teaching approaches along with institutional systems that affect the environmental education outcomes of primary school children. The research adopts the Climate Change Education for Sustainable Development framework by UNESCO along with Pedagogical Content Knowledge theory by Shulman expanded for climate education.

Climate Change Education for Sustainable Development (CCESD) UNESCO

The Climate Change Education for Sustainable Development (CCESD) framework serves as a worldwide standard that helps educational systems include climate literacy through its mechanisms created by UNESCO. The CCESD framework establishes an interdisciplinary system to function with cognitive learning develop behavioral changes and promote community participation. Learners acquire critical thinking skills together with systems thinking abilities and value-based decision-making competencies through this framework because the framework enables them to confront sustainability issues (UNESCO, 2024).

This study tends to analyze whether Pakistani primary education materials and policies develop meaningful environmental understanding by using the CCESD framework. This framework enables scholars to understand how young students learn about climate awareness and develop prepared behaviors along with becoming resilient communities. Educational institutions must incorporate climate content into their textbooks and teaching materials teacher training and whole-school approaches as they promote active local environmental education for students (UNESCO, 2016).

The framework's focus on early educational interventions follows the research goal to explain how basic learning influences future citizens who care about climate change. Within the Pakistani context, CCESD delivers an extensive framework that evaluates both curriculum materials alongside their educational methods.

Pedagogical Content Knowledge (PCK) and Its Extension to Environmental Education

The research of Lee Shulman (1986) regarding Pedagogical Content Knowledge (PCK) functions as the second theoretical foundation for teacher practice studies. It investigates the merger of subject content knowledge with instructional approaches. Teachers possess PCK capabilities through which they convert subjects into reachable learning activities that recognize student backgrounds and emotional aspects (Shulman, 1986).

This research investigates primary school teachers in Pakistan through PCK in their delivery of climate change education. The instruction of environmental subjects requires both science-based knowledge and training in creating educational methods that will activate students' intellectual abilities together with emotional responses. The framework by Shulman helps to determine if the teaching staff has suitable preparation to translate difficult environmental ideas into simple language accessible to young students. The concept holds crucial importance for this research where we assess teacher subject knowledge combined with teaching approaches regarding climate education at primary school levels.

Alignment of Theoretical Frameworks with Research Objectives

The combination of CCESD alongside PCK/EPACK frameworks provides researchers with a complete analysis system to study the educational system frameworks and teaching approaches regarding climate change in national policy documents and textbooks. The basic assessment of these materials should evaluate their effectiveness in environmental responsibility development together

with resilience learning and global citizenship education.

Through PCK and EPACK teachers gain better understanding of instruction and practice roles along with their skill development capabilities. The frameworks function as assessment instruments to verify both teacher pedagogical capabilities alongside their knowledge of climate change so they can deploy instructive lessons that produce student impact. The research provides experts with information about how prepared teachers are and their adaptations in instruction and educational challenges during climate change-focused teaching for young students.

These theories create a framework to analyze primary school climate literacy education in Pakistan by evaluating climate change themes in textbooks and curriculum policies together with teacher readiness and teaching strategies and identification of barriers impacting effective climate education for primary students.

Research Design: According to (Creswell, 2017) this research used a convergent parallel mixed-methods design to collect separate analyses of singular and quantitative data thus providing a complete view of primary schools' climate change education in Pakistan. The mixed-method approach was selected because it helps overcome single-method approach limitations and strengthens the study by using triangulation methods.

Research Paradigm The research framework operates under the pragmatic paradigm which provides flexible solutions to tackle education issues that prove difficult to resolve. The research created an appropriate basis to study the complex educational issue of climate change education while needing quantitative trends and contextual understanding (Cohen et al., 2018; Creswell, 2017).

Research Questions

1. What climate change topics are included in primary school textbooks in Pakistan?
2. What are teachers' perceptions of climate change education in primary schools?
3. What is the level of climate change awareness among primary school students?
4. How does climate change awareness differ between students in public and private schools?

Hypotheses The following hypotheses were formulated to guide the quantitative component of the study: H1: Climate change content is more extensively covered in private school textbooks than in public school textbooks. H2: Primary school students have low to moderate awareness of climate change concepts. H4: Students in private schools demonstrate higher climate change awareness than those in public schools.

Population and Sampling The population for this study consisted of primary school teachers drawn from both public and private schools in the Punjab province of Pakistan. The sample included 20 teachers, evenly divided between public and private institutions, and 200 teachers, with 100 selected from each school type. Furthermore, ten textbooks commonly used at the primary level three from the Punjab Textbook Board and three from the Oxford University Press were selected for content analysis. These textbooks included General Knowledge, Science, and Social Studies books used in Grades 3 through 5. The sampling strategy employed was stratified purposive sampling to ensure equitable representation across school types and curricular sources.

Data Collection Methods

To collect data for this study, a combination of tools was employed that aligned with both the quantitative and qualitative components of the research. Teacher questionnaire uses indicators which follow the CCESD framework to assess climate change awareness. The assessment items were specially chosen to evaluate teachers' comprehension and attitudinal responses as well as basic environmental behavioral actions.

Semi-structured interviews were conducted with selected private and public primary school teachers to gather qualitative information. The research interview arrangement followed the PCK framework. The interview protocol aimed to uncover teachers' environmental lesson approaches together with their readiness and facing classroom barriers.

The analysis framework came from UNESCO (2024) and presented itself as a structured checklist. Professors employed this analysis system

to inspect textbooks from primary schools thus establishing a standardized method to assess different climate change educational approaches in public and private learning materials. Content analysis results will be interpreted via data classifications that consider both public and private school status and their corresponding grade levels (Grades 3, 4, and 5). The project allowed researchers to check how institutions integrating climate change content divided their education programs between different grades and public versus private organizational types.

The analysis used thematic methods to find persistent themes as well as educational priorities and different ways of presenting climate-related issues. All stages in the analysis used data from teacher interviews to validate key findings therefore strengthening the interpretation through data triangulation methods (Krippendorff, 2004).

Instrument Validity and Reliability

The researchers used Khanum (2019) as their reference to develop their instruments which obtained content validity through expert examination involving curriculum and environmental education specialists. The obtained feedback from experts was used to modify and clarify the instruments for better relevance to Pakistan's primary educational context. The reliability assessment indicates through Cronbach's alpha measure that the student questionnaire provided a robust internal consistency when assessing climate awareness and engagement.

Data Analysis Procedures

Quantitative data collected from Teachers' surveys were analyzed using SPSS (Statistical Package for the Social Sciences). Descriptive statistics were employed to assess overall levels of awareness, while inferential statistics including t-tests were used to examine group differences and test the stated hypotheses. Thematic analysis of qualitative data followed the six-phase model outlined by (Braun & Clarke, 2006), and codes were developed deductively, guided by the CCESD and PCK frameworks. Textbook content was analyzed through a checklist-based content analysis procedure to evaluate the presence, depth, and pedagogical treatment of climate change topics.

Ethical Considerations The study received ethical clearance from the appropriate institutional review board. Participation was voluntary, and informed consent was obtained from all respondents, including parental consent in the case of minors. Anonymity and confidentiality were assured, and data were handled in compliance with academic ethical standards as described by (Cohen et al., 2018; Fraenkel, 1993).

Variables Description The independent variables in this study were school type (public or private), teacher training status in environmental education, and the type of textbook used (Punjab Textbook Board or Oxford). The dependent variables included student awareness of climate change, self-reported environmental behaviors, teacher perceptions of climate education, and the extent of climate-related content in textbooks.

Limitations This study was geographically limited to urban areas in the Punjab province and may not fully represent rural educational contexts. The cross-sectional nature of the research also restricted the ability to measure changes over time. Despite these constraints, the mixed-methods design and triangulation of data sources significantly enhanced the depth and credibility of the findings.

The table below shows analysis of Class 3, 4 and 5 books across General Knowledge textbooks as well as Primary Science and Social Studies by the Punjab Textbook Board (PTBB) and Oxford University Press (OUP) according to the UNESCO's framework for sustainable development and climate change education indicators.

Table 1

Class 3 General Knowledge Textbooks (PTBB vs OUP) Comparative Analysis

Indicator	PTBB Class 3 GK	OUP Class 3 GK
Total Pages Analyzed	10	4
Mentions of Climate Change	2	2
Scientific Understanding	3	4

Indicator	PTBB Class 3 GK	OUP Class 3 GK
Human Responsibility	3	4
Environmental Values	4	4
Action-Oriented Learning	4	4
Visual Content	4	4
Local Context	4	4
SDG Alignment	4	4

The table presents a comparative analysis of Class 3 General Knowledge textbooks, showing that the OUP textbook outperforms PTBB across all evaluation criteria. Climate change is mentioned three times in the OUP book, compared to only once in PTBB. OUP also offers a stronger emphasis on scientific understanding, human responsibility, and environmental values, promoting action-based learning through topics like pollution reduction and resource conservation.

The OUP textbook excels at reaching Sustainable Development Goals (SDGs) through local contextual references together with visual content because it fits SDG 13 (Climate Action) and SDG 15 (Life on Land). The wider connection indicates that the private educational curriculum better responds to worldwide educational responsibilities.

The research demonstrates the requirement to enhance public sector textbooks by including climate change education that is both practical and action-oriented for children of different ages. The analysis supports enhanced policy backing to insert UNESCO's CCESD principles in every primary-level educational material throughout Pakistan.

Table 2

Class 4 Textbooks: PTBB vs OUP Comparative Analysis

Indicator	OUP Class 4 KYW	OUP Class 4 Science	PTBB Class 4 GS	PTBB Class 4 SST
Total Pages Analyzed	10	17	10	4
Mentions of Climate Cha	0	4	10	4
Scientific Understanding	8	17	10	4
Human Responsibility	4	6	10	4
Environmental Values	5	11	10	4
Action-Oriented Learning	0	11	8	4
Visual Content	10	16	10	4
Local Context	10	13	10	4
SDG Alignment	0	13	10	4

This table presents an analysis of four Class 4 textbooks from the Punjab Textbook Board (PTBB) and Oxford University Press (OUP), assessed using UNESCO's content analysis checklist for climate change education. OUP textbooks, particularly Science and Know Your World, demonstrated a stronger integration of climate-related themes compared to PTBB books. The OUP Science book included more climate references, scientific concepts, and practical activities, while Know Your World emphasized environmental values and human responsibility. In contrast, PTBB's General Science and Social Studies textbooks presented environmental topics unevenly, with limited connection to student engagement or Sustainable Development Goals (SDGs). Although natural disasters were illustrated, links to ecological accountability were weak. OUP materials reflected a balanced approach aligned with UNESCO's CCESD framework, promoting environmental literacy and student action. These findings suggest that PTBB textbooks require significant enhancement to align with global standards, supporting student autonomy and reinforcing local relevance in climate education.

Table 3

Class 5 Textbooks: PTBB vs OUP Comparative Analysis

Indicator	PTB Class 5 GS	PTB Class 5 SST	OUP Class 5 PS	OUP Class 5 KYW
Total Pages Analyzed	9	8	7	10
Mentions of Climate Change	0	8	5	9
Scientific Understanding	8	8	7	10
Human Responsibility	9	8	7	7
Environmental Values	9	8	7	10
Action-Oriented Learning	6	5	7	4
Visual Content	9	8	6	9
Local Context	9	8	7	10
SDG Alignment	9	8	6	9

Four Class 5 textbooks from PTBB and OUP were assessed using a UNESCO-based checklist to evaluate climate change education content. The PTBB Social Studies book offered comprehensive coverage of climate change themes, integrating scientific understanding, human responsibility, and environmental values across all pages. In contrast, the PTBB Science textbook addressed environmental topics but lacked explicit climate change references. OUP's Know Your World textbook provided extensive and balanced climate change content, with nine out of ten pages referencing key themes and aligning well with SDGs. The OUP Primary Science book also covered environmental issues, though less frequently than KYW.

The PTBB teaches individual topics well but the Open University Press textbooks deliver an integrated approach especially through their student action and local context and Sustainable Development Goals (SDGs) alignment components. The evaluation suggests private educational resources better adapt to present-day educational goals yet Social Studies programs in PTBB show potential for development which could benefit other academic areas.

Combined Comparative Analysis of Climate Change Content Across Classes 3 to 5

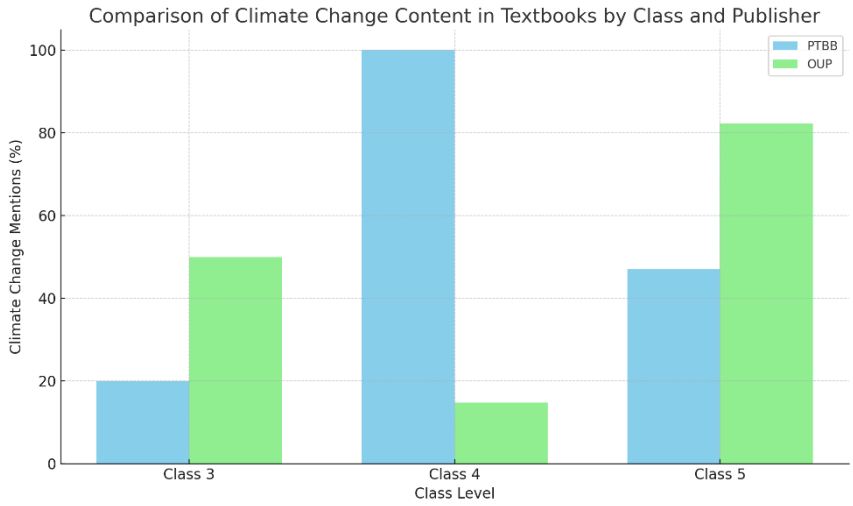
A comprehensive content analysis was conducted on General Knowledge, Science, and Social Studies textbooks from Classes 3 to 5, published by both the Punjab Textbook Board (PTBB) and Oxford University Press (OUP). The analysis focused on the frequency of climate change-related content across publishers and class levels. In Class 3 textbooks, climate change was mentioned on 2 pages each in PTBB and OUP materials. A Chi-square test revealed no significant difference between the two publishers, $\chi^2(1, N = 18) = 0.22$, $p = .64$.

For Class 4, the PTBB textbooks demonstrated substantially higher inclusion of climate change topics (14 mentions across 14 pages) compared to the OUP textbooks (4 mentions across 27 pages). This difference is statistically significant, $\chi^2(1, N = 41) = 23.82$, $p < .001$, indicating a stronger integration of climate education in public sector content at this level.

The OUP Class 5 textbook contained 14 references spread across 17 pages while the PTBB materials displayed 8 references across the same number of pages. Data from the Chi-square test demonstrated an emphasis on climate change content in private school textbooks although the results did not reach statistical significance $\chi^2(1, N = 34) = 3.22$, $p = .073$.

These results demonstrate significant differences in climate change teaching between textbook publishers and academic levels since Class 4-level textbooks from PTBB contain more extensive information than OUP textbooks in Class 5.

Figure 1.



Data presented in the bar chart indicates that PTBB and OUP textbooks from Classes 3, 4, and 5 illustrate climate change occurrences at different rates.

- Class 3: Both PTBB and OUP textbooks show equal (20%) inclusion of climate change content.
- Class 4: PTBB shows 100% coverage, while OUP shows only 14.8%.
- Class 5: OUP leads with 82.4%, and PTBB has 47%.

Figure 1 represents the percentage distribution of climate change content between PTBB textbooks and OUP textbooks from Class 3 through Class 5.during analysis it is also observed that Class 4 PTBB textbooks present more climate change content but OUP textbooks needs more attention at Class 5.

These findings were obtained through semi-structured interviews with primary school teachers from public and private institutions. Their perspectives and experiences concerning climate change education are specifically captured in this interview. The following themes showed patterns during analysis regarding educator awareness and teaching methods as well as organizational support in their delivery. The themed data sheds additional light on both challenges and potential solutions when implementing climate literacy at the primary school level.

Table 4

Theme 1: Climate Knowledge and Curriculum Content

Code	Public school Occurrences	Public School Example	Private School Occurrences	Private School Example
Climate Change Local Relevance	6	"We need more real-life examples from Pakistan."	5	"We talk about weather patterns and climate conditions in different Pakistani cities."
Climate curriculum integration	7	"The books mention pollution and environmental cleanliness, but they don't explain how human activities link to disasters."	8	"The syllabus covers types of pollution, weather, and climate but explicit climate change is minimal."
Climate change learning	5	"Whatever I know, I have learned from the news or by reading the textbook myself."	4	"Our knowledge mainly comes from textbooks and occasional online resources."

source

Schools use an indirect approach when teaching climate change by providing environmental materials that study meteorological patterns alongside pollution. Official curricular data reveals that private educational facilities excel at teaching specific climate content to their students. Public schools that offer education to the general public must incorporate local applications into their curriculum because their teachings remain disconnected from standard student life. The resource library at private schools exceeds that of public institutions but both types of educators rely mainly on textbooks and media sources to learn about climate change.

Table 5

Theme 2: Teacher Perceptions

Code	Public school Occurrences	Public School Example	Private School Occurrences	Private School Example
Teacher Understanding	10	"Climate change is due to pollution and cutting down of trees."	10	"The educational presentation on climate change provides limited information about both global warming and pollution effects."
CC Content Coverage	6	"The Science book includes pollution and conservation but not glacier melting or global warming."	7	"Basic environmental concepts like pollution and ecosystems are taught extensively."
CC_Learning_Activities	3	"I try to conduct one outdoor class monthly - tree observation or weather charting."	6	"We use activities like recycling center visits or small class projects about pollution."
Teacher Importance	2	"We should have environmental clubs in school."	5	"We should expand climate change education with more dedicated syllabus sections."

Teachers from both public and private schools display a solid foundational understanding of climate change, predominantly associating it with pollution and environmental degradation. However, private school teachers show stronger confidence and place greater emphasis on the importance of explicitly addressing climate change within educational frameworks. This is reflected through higher occurrences of climate-related learning activities in private institutions, indicating a more proactive stance toward experiential learning. Conversely, public school teachers highlight gaps in curricular coverage and suggest that climate change topics, while present, are often superficial or inadequately connected to broader ecological contexts.

Table 6

Theme 3: Teacher Pedagogy

Code	Public school Occurrences	Public School Example	Private School Occurrences	Private School Example
Teaching Methods	8	"We teach orally, ask questions, and sometimes show pictures from the book."	9	"I use interactive methods such as group discussions, multimedia, storytelling, and practical demonstrations."
Teaching Confidence	2	"Climate change is too scientific, and we were never trained how to teach it."	3	"We are confident with basic environmental topics but less so with deeper climate change details."
Teaching Challenges	8	"We have no materials or support to teach beyond the book."	8	"Limited resources, crowded syllabus, and abstract concepts of climate change pose significant challenges."

While teaching methods differ notably between the sectors with public schools predominantly employing traditional lecture-based methods due to limited resources and private schools utilizing interactive, multimedia-supported approaches both groups uniformly identify significant pedagogical challenges. Common difficulties include abstract climate concepts, inadequate teaching materials, and overloaded syllabi. Notably, despite their resource limitations, public school teachers express the need for institutional support to enable a shift toward more interactive teaching methods. Private school teachers, despite employing diverse instructional techniques, equally highlight constraints imposed by crowded curricula and limited climate-specific professional training.

Table 7

Theme 4: Teacher Received Institutional Support

Code	Public school Occurrences	Public School Example	Private School Occurrences	Private School Example
Institutional Support	3	"There is no support system for such lessons."	4	"Support from the school is minimal, mostly general teacher training sessions."

Code	Public school Occurrences	Public School Example	Private School Occurrences	Private School Example
Training received	7	"No, I have not received any special training on climate change."	6	"No specialized climate change training provided, mostly general educational workshops."

School institutions do not support adequately climate change education professional training in climate-related subjects across public and private schools. Results demonstrate that teachers at public schools receive less institutional support for their needs compared to teachers at private institutions. This indicates a substantial lack of professional training. Private institutions present better resource levels yet they mainly focus on regular education training instead of specialized climate change training. Professional development programs dedicated to climate education are crucial for policy improvement because they would benefit both public and private school systems.

Table 8

Theme 5: Student Engagement

Code	Public school Occurrences	Public School Example	Private School Occurrences	Private School Example
Student Response	8	"Students get curious when we talk about animals dying due to pollution."	9	"Students are engaged and curious, especially when discussing local environmental issues."
CC Attitude	6	"They react emotionally to natural disasters but don't know how their actions matter."	7	"Students show interest when discussing environmental impacts like pollution and animal habitats."
CC behavior	5	"Students prefer activities like role-plays and slogans 'Save Trees.'"	6	"Activities like poster-making, and trips are used to promote positive climate behaviors."

Schools present climate change content in an indirect way by teaching environmental topics about pollution and meteorological patterns. Private educational institutions show better results in teaching climate issues directly to their students when reviewing official curricula data. Educational institutions serving the public population highlight the necessity for local applications in their curriculum because their educational content seems detached from typical student experiences. Private schools possess more diverse understanding resources compared to public schools even though instructors from both sectors depend mainly on textbooks and media for climate change knowledge acquisition..

Table 9

Independent Samples T-Test comparing private and public school teachers' perceptions on climate change education

Group	N	Mean	Std. Deviation	t	p-value
Private School	100	62.28	1.73		
Public School	100	62.09	1.63	0.797	0.426

The results of the independent samples t-test, presented in the table above, reveal no statistically significant difference in the perceptions of climate change education between teachers from private and public schools ($t(198) = 0.797$, $p = .426$). While the mean perception score for private school teachers was slightly higher ($M = 62.28$, $SD = 1.73$) than that of public school teachers ($M = 62.09$, $SD = 1.63$), this difference was negligible and not significant. This outcome suggests that both groups, despite being situated in different institutional contexts, exhibit remarkably similar views regarding climate change education at the primary level. The lack of significant difference can be attributed to systemic shortcomings within the broader educational framework in Pakistan, where climate change education has not been given distinct attention or priority. Across both private and public institutions, there appears to be a shared absence of comprehensive training, resources, and curricular emphasis on climate change topics. This indicates that the issue is not confined to one sector of education, but rather reflects a pervasive gap in the national educational policy and curriculum development related to environmental and climate literacy. Consequently, these findings underscore the urgent need for systemic reforms that integrate focused climate change education into teacher training programs and school curricula uniformly across all types of schools.

Table 10

Descriptive Analysis of Teachers' Responses to Climate Change Education Items

Item	Type of Institution	Yes (%)	No (%)
Have you observed students engaging in climate-friendly behaviors?	Private	69%	31%
	Public	97%	3%
Would you support more interactive learning activities?	Private	100%	0%
	Public	100%	0%
Do you believe additional teacher training is necessary?	Private	100%	0%
	Public	100%	0%
Have you received any formal training on climate change education?	Private	0%	100%
	Public	0%	100%

Studies of categorical variable frequencies demonstrated distinct patterns among the responses teachers provided about climate change education at private and public schools. Every teacher from both private and public educational sectors confirmed that teachers require extra training in climate change education (100% agreement). Every teacher from every institution responded without exception that climate change education training has never been provided to them formally.

Teachers from private and public schools showed different responses regarding the presence of climate-friendly actions among students in their classrooms. Private educational institutions showed 69% teacher observation of these behaviors yet public school teachers witnessed this behavior in 97% of their students. Notwithstanding the variance in these results, both groups of teachers unanimously backed the introduction of interactive teaching methods about climate change since all educators from private and public schools supported this approach.

The research reveals fundamental shortages in formal training on climate change education while educators show readiness to teach interactively through student-centered strategies when their educational institutions supply proper support and resources.

Discussion

Climate change education at primary-level schools in Pakistan demonstrates minimal development alongside numerous unrelated components. General agreement regarding climate education's importance from teachers does not address the impediments created by outdated curricula as well as insufficient teacher training and institutional backing. The findings match Khanum's (2019) research findings about insufficient environmental content and lack of critical thinking or action-oriented skill development.

The entire teachers supported student-active learning methods yet lacked necessary training and tools for effective execution. The content analysis outcomes demonstrate this gap because textbooks fail to focus on action-oriented learning combined with SDG alignment. The educational policy of Pakistan operates with a fundamental structural limitation that public schools maintain similar priorities on climate literacy and private institutions.

Conclusion

This research performed textbook assessments in addition to measuring student understanding of climate change while collecting teacher opinions about climate change education within the Pakistani school system. Educational institutions have revealed wide gaps between available climate change teaching materials and support for teaching climate change content. The environmental education strategies in textbooks from PTBB public schools appear more frequent than in OUP private school textbooks but both lack substantive action plans. All teachers surveyed irrespective of working in public or private schools showed keen support for climate change instruction though they experienced insufficient professional development and inadequate teaching resources. The perceptions of teachers between private and public schools showed no significant distinctions for climate change education which points to fundamental problems in the national education standards. Formal training programs together with curriculum integrations have become essential due to a pressing need for policy transformation.

Recommendations for Policy and Practice

Incorporate climate change instruction that suits the students' age brackets according to UNESCO's educational model. The teaching methods should contain practical action-based material in textbooks alongside lesson plans. The training must be imposed as a requirement for both beginner and experienced educators who will learn about environmental and climate education. Development resources and organizational training needs should be sought from NGOs and international bodies. Educational facilities in public schools need to obtain multimedia teaching technologies alongside interactive instruction resources. Manufacture educational materials using content that highlights Pakistan's unique environmental problems and answers to these problems. The Primary Education Policy must include established climate education standards as a national standard. The government should unite with education boards and environmental organizations to advance climate initiatives in educational institutions across Pakistan. The organization should create student-led environmental clubs at schools to add tree planting as a main campaign activity. Educational organizations should create parent and community awareness programs to engage them in sustainability projects. Research teams should conduct multicontinued studies to measure how climate education remedies influence learning results during extended periods. Research the effects of new climate curricula on student learning results after curriculum changes take place. A study should examine how climate education programs are executed in different geographic areas of Pakistan.

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