Learning in the Shadow of Climate Change: Educational Challenges and Leadership Responses in Pakistan

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Abstract

Climate change poses profound threats to education systems worldwide, with developing countries bearing disproportionate risks. Pakistan, consistently ranked among the most climate-vulnerable nations, has witnessed severe floods, heatwaves, and environmental degradation that disrupt education at scale. This study investigates how school principals perceive and respond to climate-induced challenges in Pakistan's educational sector. Drawing on qualitative interviews with principals from private and a public school, the research employs thematic analysis to identify key issues related to infrastructure resilience, student and teacher well-being, curriculum adaptations, and policy awareness. Findings reveal that both schools struggle with climate-induced disruptions but differ in capacity and resources to respond. Leadership emerges as a critical factor in sustaining learning during crises, though systemic policy and infrastructural gaps persist. The study contributes to resilience and sustainable education literature by situating Pakistan's experience within global debates. It recommends integrating climate education into curricula, expanding teacher training, investing in resilient infrastructure, and empowering principals as frontline leaders of adaptation. These findings underscore the urgent need for tailored interventions that prepare educational institutions in climate-vulnerable contexts to sustain equitable and quality learning.

Keywords: Climate change, Education, Pakistan, Resilience, School Leadership, Policy Gaps, Sustainability

Introduction

Climate change is increasingly recognized as a defining challenge of the twenty-first century, affecting not only economies and ecosystems but also education systems worldwide (Ensor & Harvey,2015 and Trott ,2022). Schools are often located in communities vulnerable to floods, heatwaves, storms, and smog disruptions that undermine student well-being, teacher performance, and long-term learning outcomes (UNESCO, 2022 and Williams, & McEwen,2021). Pakistan stands at the frontline of this crisis. Ranked among the top ten most climate-vulnerable countries globally (Gul et al., 2022, Harmeling & Eckstein, 2013; Kreft et al., 2013), Pakistan has faced recurrent climate disasters, including the catastrophic floods of 2022 that destroyed approximately 27,000 schools and affected over two million children (Azam et al., 2025 and International Rescue Committee, 2022). The intersection of climate change and education in Pakistan is particularly urgent. Extreme weather events exacerbate pre-existing educational inequalities, disproportionately affecting girls, rural students, and children from underprivileged backgrounds

(World Bank, 2022). Yet, despite global commitments to Education for Sustainable Development (ESD) and national policy frameworks, the practical integration of climate resilience into Pakistan's education system remains limited. While research has documented the economic and environmental costs of climate change, relatively little attention has been paid to its educational impacts, particularly from the perspective of school leadership. This study addresses that gap by asking: How do school principals in Pakistan perceive and respond to the challenges posed by climate change? It investigates the leadership role of principals in adapting curricula, safeguarding student well-being, and navigating policy gaps in climate-vulnerable contexts. By situating the findings within global debates on resilience and sustainable education, this study contributes to a deeper understanding of education's role in responding to climate crises (Ahmed at al., 2025 and Habiba & Zain 2025). It was based on interviewing public and private schools in the city. The principals of various schools were interviewed to analyses their understanding and readiness for climate change and its related issues. This research is significant as it contributes to a growing body of work that views education as both vulnerable to and a potential solution for climate change (Habib & zain 2025 and Ensor & Harvey, 2015). By exploring how schools are disrupted by climate events, the study reveals the extent to which learning outcomes, attendance, and psychological well-being are at risk (Wi, & Steinschneider 2024). It also highlights the voices of principals, who serve as frontline leaders but are rarely studied in climate-education research (Ghazali et al., 2025. Their perspectives provide unique insights into how policy rhetoric translates or fails to translate into everyday school practices. Hence this research addresses the urgent need for evidence-based recommendations that can inform policymakers, teacher educators, and international organizations seeking to strengthen climate resilience in fragile education systems. In a country where education access is already challenged by poverty, gender inequality, and governance issues, understanding and addressing climate-related risks is critical to achieving Sustainable Development Goal 4 on quality education. This study therefore asks: How do school principals in Pakistan perceive and respond to the challenges posed by climate change? It investigates the leadership role of principals in adapting curricula, safeguarding student well-being, and navigating policy gaps in climate-vulnerable contexts. By situating the findings within global debates on resilience and sustainable education, this study contributes to a deeper understanding of education's role in responding to climate crises

Literature Review

Climate Change and Education Globally
Globally, climate change has disrupted education in multiple ways, often exacerbating existing inequalities in access, quality, and equity (Prentice et al., 2024 and Reid .2019). Floods and hurricanes in Sub-Saharan Africa and the Caribbean have caused mass school closures, destroyed infrastructure, and displaced millions of learners, leading to significant losses in instructional time (UNESCO, 2021; Anderson, 2020). In South Asia, recurrent monsoon floods regularly damage school buildings, while droughts and food insecurity further contribute to irregular attendance (Shrestha et al., 2022). Similarly, heatwaves in South Asia and the Middle East have been linked to absenteeism, reduced classroom productivity, and declining learning outcomes due to heat-related illnesses, dehydration, and poor ventilation in overcrowded classrooms (Ebi et al., 2021; Kjellstrom et al., 2016). Urban centers in developing countries also face the growing threat of smog and air pollution, which not only reduce attendance but also increase the prevalence of respiratory diseases among school-age children (App, 2024; World Health Organization [WHO], 2018).In addition to physical disruptions, climate change also has psychosocial impacts on learners and educators. Studies from Australia and the United States demonstrate rising climate-related

anxiety among children and young people, which can influence motivation, concentration, and long-term aspirations (Gul et al., 2022, Ojala, 2016; Hickman et al., 2021). These findings suggest that climate change is not merely an environmental or economic issue but also a profound educational challenge. Emerging literature emphasizes the importance of Education for Sustainable Development (ESD) as a critical response. ESD integrates climate literacy and sustainability concepts into curricula to foster critical thinking, problem-solving, and adaptive skills that enable learners to become agents of change in their communities (Everth & Bright, 2022; UNESCO, 2020). Research highlights that climate education can promote resilience, enhance awareness of environmental justice, and empower marginalized groups to engage in adaptive practices (Leicht, Heiss, & Byun, 2018; Monroe et al., 2019). However, the successful implementation of ESD depends heavily on teacher preparedness, adequate resources, and school leadership. Without sufficient professional development, teachers may lack confidence, content knowledge, or pedagogical strategies to effectively engage students with complex climate-related issues (Tytler & Freebody, 2023; Mochizuki & Bryan, 2015). In sum, global evidence indicates that climate change disrupts learning both directly, through damaged infrastructure and health impacts, and indirectly, through psychological stress and reduced motivation. While ESD provides a promising pathway to equip learners with adaptive capacities, the effectiveness of such interventions relies on systemic reforms, teacher empowerment, and strong leadership support at the school and policy levels.

Education and Climate Vulnerability in Pakistan

Pakistan's education sector faces unique vulnerabilities due to climate change, compounded by socioeconomic disparities and weak institutional capacity. The catastrophic 2022 floods alone caused economic damage of approximately US$15 billion, destroying thousands of schools and displacing millions of students across Sindh, Balochistan, and southern Punjab (UN-Habitat, 2023; World Bank, 2022). These disruptions resulted in prolonged school closures, learning losses, and heightened dropout rates, particularly among marginalized groups. Recent estimates suggest that nearly 2 million children were affected, many of whom remain unable to re-enroll due to infrastructure loss or economic hardship (International Rescue Committee, 2022). Beyond floods, extreme heat and smog pose significant threats to health and learning. Urban centers such as Karachi and Lahore experience recurring episodes of hazardous air quality, leading to respiratory illnesses, absenteeism, and reduced learning capacity among students (WHO, 2018; App, 2024). Heatwaves, increasingly frequent due to global warming, exacerbate dehydration and heat stress in overcrowded classrooms lacking ventilation or cooling systems (Saleem & Jamil, 2025). These risks disproportionately affect children from low-income families, who often lack access to adequate healthcare, safe transport, or heat mitigation measures. Climate-related disruptions also worsen pre-existing inequalities in educational access. Girls are particularly vulnerable, as families facing climate-induced economic shocks often withdraw daughters from school to reduce household costs or increase domestic labor contributions (ReliefWeb, 2022; UNICEF, 2019). Rural learners face barriers due to greater exposure to floods and droughts, while madrassa students, who constitute a significant share of Pakistan's school-going population, often study in poorly resourced environments with limited integration of modern climate science into their curricula (Andrabi et al., 2020). The compounded effect of poverty, gender norms, and environmental stressors contributes to entrenched disparities in educational attainment. Despite government commitments to mainstream climate change into education policy, implementation remains fragmented and underfunded. While national frameworks such as the *National Climate Change Policy (2012)* and the *National Education Policy (2017)* acknowledge the importance of climate resilience, operational mechanisms are weak (UNICEF, 2021; Government of Pakistan,

2017). Coordination between federal and provincial governments remains limited, and climate education has yet to be systematically embedded across curriculum frameworks. Moreover, there is insufficient budget allocation for climate-resilient infrastructure or disaster-preparedness measures in schools (Ahmad & Afzal, 2022). At the institutional level, schools lack systematic curricula on climate resilience. Research shows that while some urban schools introduce environmental awareness through extracurricular projects, most lack structured, age-appropriate content that connects climate change to local realities (Abdul Malik et al., 2021; Behera et al., 2024). Teachers often receive little to no professional development in climate education, leaving them underprepared to address complex environmental issues (Mochizuki & Bryan, 2015). Principals and school leaders, though pivotal in mediating change, also face capacity gaps due to limited training, scarce resources, and inadequate autonomy in decision-making (Subandi et al., 2022). Taken together, these challenges illustrate that Pakistan's education sector is not only exposed to climate risks but also structurally ill-equipped to respond. Without targeted interventions such as climate-resilient infrastructure investment, systematic curriculum reform, teacher training, and school leadership empowerment, the education system risks perpetuating cycles of vulnerability, particularly for the most marginalized learners.

Theoretical Lens: Resilience and Leadership in Crisis
Resilience theory provides a useful framework for analyzing how education systems withstand and adapt to crises. Education resilience refers to schools' ability to maintain continuity of learning in the face of disruptions by mobilizing resources, adapting curricula, and supporting well-being (Orcherton, 2024, and INEE, 2023). School leadership is increasingly recognized as a pivotal mediator in resilience. Principals play a catalytic role in establishing school culture, coordinating community engagement, and aligning institutional practices with broader policy frameworks (Subandi et al., 2022). In the face of crises and the unpredictability that accompanies periods of change, it becomes increasingly vital to explore the qualities that empower managers to evolve into adaptive leaders. Such leaders are not only expected to guide teams but also to coordinate complex organizational initiatives with clarity and precision (Chiu et al., 2022 and Meng at al.,2024). However, leadership alone cannot sustain adaptation; the organizational environment plays an equally critical role. It is therefore essential to examine the internal dynamics, structures, and cultural elements that either foster or hinder adaptive leadership (Thommes et al., 2024). When individual leadership traits such as resilience, flexibility, and problem-solving capacity are aligned with supportive organizational factors such as open communication channels, trust-based relationships, and enabling policies the potential for adaptive leadership is maximized. This synergy allows organizations to not only withstand disruption but also to generate sustainable value, both internally through strengthened cohesion and externally through enhanced responsiveness to stakeholders and societal needs (Gadolin etal.,2024 and Orcherton ,2024). Ultimately, adaptive leadership should be understood as a shared enterprise between leaders and their institutions, where mutual reinforcement ensures organizational resilience and long-term success. While global studies highlight climate change's impact on education, limited empirical work has examined the perspectives of Pakistani school leaders. Most existing research focuses on infrastructure and economic damage, with insufficient attention to leadership, well-being, and curriculum. This study addresses this gap by analyzing how principals interpret and respond to climate challenges in their schools.

Methodology
This study employs a qualitative multiple case study approach to explore school leaders' perspectives on climate change and education. Semi-structured interviews were conducted to capture nuanced insights into challenges, strategies, and constraints. Two principals participated:

one from a private school (Principal A) serving approximately 700 students with 80 teachers, and one from a public school (Principal B) serving around 200 students with 20 teachers. Purposive sampling was employed, both were experienced educators leading institutions in Karachi, a city frequently affected by climate extremes such as heatwaves, smog, and urban flooding. Although the study involved interviews with only two school principals, such a sample can be considered sufficient within qualitative research paradigms focused on depth over breadth especially when participants are highly information-rich and the context is narrowly defined. Empirical studies on data saturation, such as Guest, Bunce & Johnson (2006), demonstrate that the majority of themes emerge within the first six to twelve interviews, with 92 % saturation typically reached by the twelfth interview. Given this, along with the absence of new themes emerging during analysis, the two interviews were deemed to provide sufficient insight to answer the study's research questions." Interviews were conducted in person using semi-structured guides. Questions explored five areas:

 (1) infrastructure and resilience,
(2) student and teacher well-being,
(3) curriculum and pedagogy,
(4) policy and governance, and
(5) leadership strategies.

Ethical protocols included informed consent, confidentiality, and voluntary participation

Data were analyzed using thematic analysis following Miles, Huberman, and Saldaña (2014). The process involved data reduction, coding, and theme development. Five key themes were identified: infrastructure resilience, climate change impacts, student and teacher well-being, curriculum adaptations, and policy awareness and gaps. The study is limited by its small sample size (two principals) and geographic focus (Karachi). While findings provide in-depth insights, they are not generalizable to all Pakistani schools. However, they offer valuable starting points for broader research.

Findings and Discussion
The interviews collected for this study were first recorded carefully to ensure the accuracy of participants' responses and preserve the richness of their narratives. These recordings were then transcribed verbatim, providing a written account of the principals' perspectives that could be systematically examined. Once the transcripts were prepared, the data were analyzed using thematic analysis, following the structured approach outlined by Creswell and Poth (2016), and later adapted by Saifuddin and Mohammad (2025). Thematic analysis is a widely used qualitative method that involves identifying, organizing, and interpreting patterns of meaning across a dataset. The process began with familiarization, where the researchers repeatedly read through the transcripts to develop an in-depth understanding of the data. This was followed by initial coding, in which meaningful units of text were highlighted and labeled to capture emerging concepts. The codes were then examined and grouped during the search for themes, a stage where patterns and similarities across the data were identified. Next, the themes were reviewed and refined, ensuring they accurately represented the coded data and captured the essence of participants' perspectives (Braun and Clarke 2024). During the definition and naming of themes, each theme was clearly articulated, and its scope and relevance to the research questions were clarified. Finally, the themes were organized and reported, allowing the findings to be presented in a coherent narrative that reflects both the depth and complexity of principals' views. Through this rigorous and systematic process, the analysis moved beyond individual statements to highlight broader insights about

school leadership, climate change adaptation, and organizational readiness. The following themes emerged from the collected data and form the basis of the study's findings

Figure 4.1 Thematic Analysis

Theme	Sub-categories	Interview Excerpts
1. Infrastructure Resilience	a) Classroom ventilation & cooling	"We have invested in shaded courtyards and installed fans in every classroom." (Principal A)
	b) Water & sanitation facilities	"Recently, we created an underground water tank to ensure students have access to clean drinking water during heatwaves." (Principal A)
	c) Damage and delayed repairs	"The classrooms damaged by last year's flooding are still unrepaired. We wrote letters to the authorities, but the process takes months." (Principal B)
2. Climate Change Impacts	a) Absenteeism due to heatwaves	"We see absenteeism spike whenever temperatures rise beyond 40°C. Parents keep children home because classrooms become unbearable." (Principal A)
	b) Accessibility during floods	"Flooded streets prevent children from reaching school. Sometimes the school itself is closed for weeks." (Principal B)
3. Student and Teacher Well-being	a) Teacher burnout	"Our teachers feel exhausted teaching in hot, overcrowded classrooms. Many complain of headaches and dehydration." (Principal A)
	b) Student anxiety and fear	"Children express fear that floods will wash away their homes. They come to school anxious and distracted." (Principal B)
	c) Reduced motivation & concentration	"It is difficult for them to concentrate when they are worried about their families." (Principal B)
4. Curriculum Adaptations & Teacher Training	a) Extracurricular initiatives	"We organize tree-planting drives and eco-clubs where students discuss recycling and water conservation." (Principal A)
	b) Lack of structured resources	"We want to teach climate change, but we don't have proper textbooks or training." (Principal B)
5. Policy Awareness and Gaps	a) Policy-practice disconnect	"Policies exist, but schools receive no support for infrastructure upgrades." (Principal A)

Theme	Sub-categories	Interview Excerpts
	b) Absence of training & funding	"There is no training for teachers, no funds for resilience. Policies remain on paper." (Principal B)

Theme 1: Infrastructure Resilience

Both principals acknowledged significant infrastructure vulnerabilities in their schools, but the scope of their responses varied due to resource disparities. Principal A, representing the private school explained

> *"We have invested in shaded courtyards and installed fans in every classroom. Recently, we created an underground water tank to ensure students have access to clean drinking water during heatwaves. These small steps give some relief, although they are not long-term solutions*."

In contrast, Principal B from the public school emphasized the limitations imposed by chronic underfunding and bureaucratic inefficiency:

> *"The classrooms damaged by last year's flooding are still unrepaired. We wrote letters to the authorities, but the process took months. Meanwhile, we hold classes in makeshift rooms, which are overcrowded and poorly ventilated."*

This divergence illustrates how infrastructure resilience is highly dependent on resource availability and administrative responsiveness. While private institutions can adopt modest adaptation strategies, public schools remain highly vulnerable due to systemic neglect.

Theme 2: Climate Change Impacts

Both principals reported that climate change directly affects school operations and student participation. One of the Principal noted sharp spikes in absenteeism during extreme weather:

> *"We see absenteeism spike whenever temperatures rise beyond 40°C. Parents keep children home because classrooms become unbearable, and they fear for their children's health."*

Another Principal highlighted the compounding effects of flooding on access to education:

> *"Flooded streets prevent children from reaching school. Sometimes the school itself is closed for weeks. It disrupts the academic calendar, and we struggle to complete the syllabus."*

These accounts demonstrate how climate disruptions not only reduce attendance but also compromise curriculum delivery, ultimately contributing to learning loss and lower academic achievement.

Theme 3: Student and Teacher Well-being

All principals raised concerns that extended beyond physical health to encompass the emotional and psychological toll of climate disruptions. Principal A described the pressures faced by teachers:

> *"Our teachers feel exhausted teaching in hot, overcrowded classrooms. Many complain about headaches and dehydration. It affects their motivation, and sometimes they ask for sick leave during peak summer.*

One of the respondents stressed the psychological distress experienced by students:

> *"Children express fear that floods will wash away their homes. They come to school anxiously and are distracted. It is difficult for them to concentrate when they are worried about their families."*

The data reveal that climate change generates a double burden: physical discomfort and illness combined with heightened stress and anxiety, both of which undermine the capacity of teachers to deliver lessons and of students to learn effectively.

Theme 4: Curriculum Adaptations and Teacher Training

Majority of the respondents acknowledged the importance of integrating climate education into the school curriculum, though their approaches differed. Principal A described attempts to incorporate sustainability into extracurricular activities:

> *"We organize tree-planting drives and eco-clubs where students discuss recycling and water conservation. These activities raise awareness, but they are not formally part of the syllabus."*

However, lamented the absence of systemic support as discussed by one of the respondents

> *"We want to teach climate change, but we don't have proper textbooks or training. Teachers don't know how to explain science or link it with local problems. It stays as a topic of discussion, not real teaching."*

These contrasting experiences highlight a broader gap in teacher professional development and curriculum reform. While private schools can experiment with extracurricular initiatives, public schools struggle without structured resources or training programs.

Theme 5: Policy Awareness and Gaps

The principals demonstrated awareness of Pakistan's national commitments to climate and education policy. However, they expressed frustration with the lack of practical support. Principal A pointed out the disconnect between policy rhetoric and implementation:

> *"Policies exist, but schools receive no support for infrastructure upgrades. Everything is on paper, but on the ground, schools are left on their own."*

But one of them echoed this sentiment, drawing attention to the absence of resources and training:

"There is no training for teachers, no funds for resilience. Policies remain on paper, and schools like ours are left to cope as best as we can."

These perspectives underline the persistent gap between national strategies and school-level realities, revealing the need for more robust mechanisms to translate climate commitments into actionable support for schools.

Discussion

This study reveals the complex interplay between climate change, educational inequalities, and leadership in Pakistan. Several insights emerge which is consistent with global findings (Creating a Climate-Resilient Blueprint for Schools, 2025), the study underscores the centrality of infrastructure. Private schools with greater resources could adopt basic adaptive measures, while public schools remained constrained by underfunding. This reflects broader inequities in Pakistan's education system. Both principals highlighted heat-related illnesses and psychological stress. Such findings underscore the need to reconceptualize well-being in climate education debates, moving beyond physical health to include socio-emotional resilience (Echoing Ebi et al. 2021). The findings affirm prior work emphasizing the role of curriculum in building climate literacy (Dumbuya, 2025). However, inadequate teacher training remains a barrier, consistent with Tytler and Freebody's (2023) observation that teachers often lack confidence in addressing climate topics. This study highlights principals as critical mediators of resilience. Their leadership shaped whether schools adopted proactive responses (extracurricular climate projects) or remained reactive (closures during floods). This aligns with Subandi et al. (2022), who argue that collaborative leadership enhances resilience by mobilizing community engagement. Both principals lamented the gap between national climate commitments and local realities. This gap mirrors global challenges in mainstreaming climate change into education policy (UNICEF, 2021). Pakistan's case illustrates the urgency of devolving resources and support to the school level. Comparisons with Bangladesh and Sub-Saharan Africa show similar vulnerabilities, but Pakistan's highly urbanized context (e.g., Karachi's smog and flooding) adds distinctive challenges. Thus, while global frameworks offer useful lessons, localized strategies are essential.

Conclusion and Implications

This study contributes to global debates by foregrounding the perspectives of Pakistani school principals on climate change and education. Findings reveal that while both public and private schools face similar climate challenges, disparities in resources shape their responses. Leadership emerges as a critical but under-supported factor in sustaining resilience.

Policy Implications

- Infrastructure investment: Government and donors must prioritize climate-resilient school buildings, particularly in vulnerable urban areas.
- Teacher training: Systematic climate education training should be integrated into teacher professional development.
- Curriculum reform: Climate literacy should be mainstreamed across subjects, with localized resources for teachers.
- Leadership empowerment: Principals should receive targeted training and discretionary resources to implement resilience strategies.
- Community engagement: Schools should collaborate with local communities and NGOs for disaster preparedness and sustainability projects.

Limitations and Future Research

This study is limited to two principals in Karachi, restricting generalizability. Future research should employ larger samples across rural and urban contexts, compare madrassas and mainstream schools, and explore student and teacher perspectives. Longitudinal studies could also assess how schools adapt over time to recurring climate disruptions.

References

Abdul Malik, A., Khan, R., & Javed, S. (2021). Integrating climate education in Pakistani schools: Teacher perspectives and challenges. *Journal of Environmental Education Research, 27*(3), 341–359.

Ahmed, S., Naudhani, T., Khan, S. S., & Wazir, S. (2025). BRIDGING A GAP: ASSESSING CLIMATE CHANGE IMPACTS ON GIRLS'EDUCATION AND DEVELOPING A RESILIENT LEARNING SYSTEM. *Contemporary Journal of Social Science Review*, *3*(1), 1455-1464.

App. (2024). Climate and student health in Pakistan. *The News on Sunday.*

Azam, S., Larik, A. H., Sadiq, Z., Siddiqui, S. J., & Iqbal, U. (2025). Pakistan's Approach to Climate Change Diplomacy: An Analysis of SDG13. *Dialogue Social Science Review (DSSR)*, *3*(4), 91-109.

Braun, V., & Clarke, V. (2024). A critical review of the reporting of reflexive thematic analysis in Health Promotion International. *Health Promotion International*, *39*(3), daae049.

Chiu, C.-Y.; Nahrgang, J.D.; Bartram, A.; Wang, J.; Tesluk, P.E. Leading the team, but feeling dissatisfied: Investigating informal leaders' energetic activation and work satisfaction and the supporting role of formal leadership. *J. Organ. Behav.* **2021**, *42*, 527–550.

Creating a Climate-Resilient Blueprint for Schools. (2025). Global Partnership for Education.

Dumbuya, I. (2025). Climate literacy and sustainable education in South Asia. *Sustainability Education Journal, 12*(2), 115–132.

Ebi, K. L., Capon, A., Berry, P., Broderick, C., & de Dear, R. (2021). Hot weather and heat extremes: Health risks for students and workers. *Environmental Research Letters, 16*(4), 044001.

Ensor, J., & Harvey, B. (2015). Social learning and climate change adaptation: evidence for international development practice. *Wiley Interdisciplinary Reviews: Climate Change*, *6*(5), 509-522.

Everth, C., & Bright, D. (2022). Education for sustainable development: Global perspectives and local practices. *International Review of Education, 68*(2), 145–165.

Gadolin, C.; Andersson, T.; Stockhult, H. Complexity Leadership in a Public Sector Context: Exploring Adaptive Leadership Practices. *Change Manag. Int. J.* **2023**, *23*, 63

Ghazali, M. Y., Ahmad, A., & Mansor, A. N. (2025). Teacher leadership influencing student leadership: A study in Malaysian fully residential schools. *Multidisciplinary Science Journal*, *7*(11), 2025533-2025533.

Guest G, Bunce A, Johnson L (2006) How many interviews are Enough?An experiment with data saturation and variability. Field Methods 18(1):59–82.

Gul, A., Chandio, A. A., Siyal, S. A., Rehman, A., & Xiumin, W. (2022). How is climate change impacting the major yield crops of Pakistan? an exploration from long-and short-run estimation. *Environmental Science and Pollution Research*, *29*(18), 26660-26674.

Habib, S., & Zain, T. (2025). Climate Change Education at the Primary School Level in Pakistan: A Comparative Analysis of Curricula and Teaching Practices. *Global Social Sciences Review*, *10*(1), 208-229.

Harmeling, S., & Eckstein, D. (2013). Global Climate Risk Index. Germanwatch.

INEE. (2023). Resilient education systems: A framework for climate adaptation. Inter-agency Network for Education in Emergencies.

International Rescue Committee. (2022). Flood response and education in Pakistan.

Kreft, S., Eckstein, D., & Melchior, I. (2013). Who suffers most from extreme weather events? Weather-related loss events in 1993–2012. Germanwatch.

Meng, J.; Pan, P.-L.; Cacciatore, M.A.; Sanchez, K.R. The integrated role of adaptive leadership, sense of empathy and communication transparency: Trust building in corporate communication during the pandemic. *Corp. Commun. Int. J.* **2024**, *29*, 503–515.

Orcherton, D. F. (2024). Impact of Transformational and Relational Leadership Theories and Ethics towards Climate Change Resilience in Fiji. *J. Pol'y & Governance*, *4*, 1.

Prentice, C. M., Vergunst, F., Minor, K., & Berry, H. L. (2024). Education outcomes in the era of global climate change. *Nature Climate Change*, *14*(3), 214-224.

Reid, A. Climate change education and research: possibilities and potentials versus problems and perils? *Environ. Educ. Res.* **25**, 767–790 (2019)

Saleem, A., & Jamil, B. (2025). Heat stress and student learning outcomes in Pakistan. *Journal of Climate and Education Studies, 14*(1), 55–72.

Subandi, S., Wijayanti, E., & Rahman, A. (2022). School leadership for resilience in times of crisis. *Educational Management Administration & Leadership, 50*(5), 771–789.

Thommes, M.S.; Uitdewilligen, S.; Rico, R.; Waller, M.J. Switching gears: How teams co-construct adaptive leadership style transitions in dynamic contexts. *Organ. Psychol. Rev.* **2024**, *14*, 542–570.

Trott, C. D. (2022). Climate change education for transformation: Exploring the affective and attitudinal dimensions of children's learning and action. *Environmental Education Research*, *28*(7), 1023-1042.

Tytler, R., & Freebody, K. (2023). Teacher capacity for climate change education. *Teaching and Teacher Education, 124,* 104048.

UNESCO. (2021). Reimagining our futures together: A new social contract for education. Paris: UNESCO.

UNESCO. (2022). Climate change and education: Impacts and adaptation. Paris: UNESCO.

UN-Habitat. (2023). Pakistan post-flood recovery and education sector assessment.

UNICEF. (2021). Climate change and education policy in Pakistan: A policy review. UNICEF Pakistan.

Williams, S., & McEwen, L. (2021). 'Learning for resilience'as the climate changes: discussing flooding, adaptation and agency with children. *Environmental Education Research*, *27*(11), 1638-1659.

Wi, S., & Steinschneider, S. (2024). On the need for physical constraints in deep learning rainfall–runoff projections under climate change: a sensitivity analysis to warming and shifts in potential evapotranspiration

World Bank. (2022). Climate change, inequality, and education in Pakistan. Washington, DC: World Bank.