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Bridging Climate Science and Literacy Education: Policy and Pedagogical Strategies for Primary Schools

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Abstract

This paper examines the multifaceted impacts of the climate crisis on primary education, emphasizing the urgent need to integrate climate literacy into curricula. Extreme weather events disrupt educational access through school closures, infrastructure damage, and resource scarcity, disproportionately affecting Global South communities. The study highlights innovative pedagogical approaches—including experiential learning and interdisciplinary climate education—to foster student agency and environmental stewardship. It simultaneously addresses systemic barriers, particularly socioeconomic disparities in resource allocation and the digital divide, which exacerbate educational inequalities. The analysis underscores the critical role of policy interventions, such as teacher training programs and equitable curriculum reforms, in building climate-resilient education systems. By synthesizing current research, the paper identifies gaps in climate literacy frameworks for young learners and calls for evidence-based strategies to align educational practices with climate mitigation goals. Ultimately, it positions education as both a vulnerable sector and a vital catalyst for sustainable societal transformation, advocating for immediate cross-sectoral action to address this generational challenge.

Keywords: crisis, climate literacy, primary education, socioeconomic disparities, policy interventions

1. Introduction to Climate Crisis and Education

Understanding of education is paramount for learning, as it is the driving force for shaping thought processes and world view of an individual. Policies surrounding education are being gridlocked with the growing concern for the climate crisis (Von Homeyer et al., 2021). There is a significant relationship between the quality and reach of education to natural calamities and how cognitive abilities are developed. One of the newer discourses is to explore how detrimental the climate crisis is to education (Chaudhary & Piracha, 2021). The consequence of environmental change, particularly climate crisis, hinders the ability to access education, create a learning environment, lead to the shutting down of educational facilities and schools, and so much more (Azevedo et al., 2021). This is an ongoing global health situation which concerns all countries and territories, and their education systems.

This note deals with the impact of the climate crisis through a health lens on the education of primary school students, and hence, a need to develop climate literacy among different stakeholders in the education system such as teachers, parents, and young students (Rousell & Cutter-Mackenzie-Knowles, 2020). It focuses on primary level school children, as they are an often-overlooked group in the resource-strapped educational programs (Taripe, 2024; Lawson & Lawson, 2020).

As the climate crisis becomes an increasingly significant barrier in the global south, where devastating floods, destructive hurricanes, and powerful cyclones relentlessly jeopardize the lives and well-being of countless individuals, it is undeniably heart-wrenching to witness the immense suffering that ensues. However, amidst the visible ramifications, there exists an often disregarded but monumental consequence that profoundly impacts our educational systems, thus imperiling the long-term development of a nation's human capital (White et al., 2022; UNICEF, 2021).

1.1. Defining Climate Crisis and its Impacts on Education

Climate crisis is known as the rapid disruption in weather patterns. This increase is occurring because of mainly more carbon dioxide and other gases used by humans to do their work. Due to the increase in carbon dioxide, the average temperature on the planet has raised. Oceans have become more acidic due to the more carbon dioxide dissolved in them over time. Because of climate change, winters have become warmer, and snow and ice data shows decrease over the last 6 decades (Lindsey & Dahlman, 2020; Mikhaylov et al., 2020; Zhang et al., 2020; Ali et al., 2022). This has led to significant changes in weather patterns and has affected various aspects of life, including agriculture and wildlife. One of the most significant impacts of climate crisis on education is its effect on the availability of resources such as books and school materials (Ferri et al., 2020). As a result, many primary school students in affected areas struggle with limited access to educational materials and resources, hindering their literacy development (UNESCO, 2021; Akram et al., 2021).

The impact of climate crisis on education has become a growing concern, particularly in addressing the literacy issues of primary school students. It is important to understand the ways in which climate crisis affects the learning abilities of young students. One of the main impacts is the disruption of regular school attendance due to extreme weather events. This can lead to missed learning opportunities and hinder the development of literacy skills in primary school students (Clarke et al., 2022). Additionally, the

climate crisis can also affect the availability of educational resources, further exacerbating the literacy issues faced by primary school students (Jones & Davison, 2021). For example, extreme weather events can disrupt school schedules and access to learning materials, making it difficult for students to consistently engage in reading and writing activities. In addition, environmental changes may also lead to the displacement of communities, resulting in a lack of access to educational resources and support. This can further exacerbate the literacy issues faced by primary school students, making it crucial to implement targeted interventions and support systems. One approach to addressing this is to incorporate climate education into the literacy curriculum, helping students understand the impact of environmental changes on their communities and the world (Ferri et al., 2020; Jeste et al., 2020).

This can be achieved through integrating environmental themes into language arts lessons, using literature and non-fiction texts that explore climate-related issues. Students can also benefit from hands-on activities such as creating their own stories or poems about the environment. This can help them develop their literacy skills while also raising awareness about environmental issues (Siegener & Stapert, 2020). Additionally, incorporating climate crisis education into the curriculum can empower students to become environmentally conscious citizens. This can be achieved through interactive learning activities and projects that highlight the importance of environmental sustainability. Additionally, incorporating literature and reading materials that focus on climate change and its impact on the environment can also help in addressing the literacy issues of primary school students (Ruiz-Mallén et al., 2022; Jones & Davison, 2021).

1.2. The educational community in Climate Crisis Education

The education community needs to stress the impacts of the climate crisis and understand the importance of education about the crisis to be more significant. The education community should become more active in discussing educational disparities by mapping the consequences of educational disruption and ensuring that education is a priority for communities, governments, international institutions or organizations in both the short and long term. Education about the climate crisis is increasingly critical. The education community should stress the impacts of the climate crisis, and the importance of education about the crisis. It is also in the education community's long-term interest to understand and map the consequences - both foreseeable and unintended - of educational decisions in response to the crisis (Kopnina, 2020; Rousell & Cutter-Mackenzie-Knowles, 2020).

There have been a number of successful programs and strategies implemented in different regions and grade levels that have made efforts to address these literacy issues of students who are suffering from the impact of the climate crisis. Although the landscape, resources, and needs of students can be divergent, the strategies employed can offer valuable insights and suggestions for other preschool, primary, and secondary education systems (Kamil et al., 2020).

2. Importance of Literacy and climate crisis Literacy in Addressing Climate Crisis

The climate crisis presents a multitude of challenges on physical, economic, social, and political levels (Fuentes et al., 2020). At the

top of the 'action pyramid,' as academics uniquely positioned to impact students, we posit the importance of facilitating our learners' agency to engage critically in this crisis (Shapiro et al., 2021). Without environmental literacy, students may not wholly understand the debates and events discussed in the news. If they cannot be expected to do so, they will be limited in their ability to be active and 'responsible' citizens (Hodson, 2020).

At baseline, literacy is consistently positioned as central to the processes necessary to address the global challenge of climate crisis (Oliver & Adkins, 2020). Specifically, literacy education is often highlighted in communication about this challenge because through it, literate people will have 'the ability to understand the complex issues related to climate, both in terms of the science of the issues, and also in terms of responses to it.' Fostering a sense of agency is a key goal of environmental education, with Deep Ecological and Ecofeminist approaches emphasizing the interconnectedness of people and the environment, and seeing the root cause of the eco-social crisis as a consequence of disconnection (Hung, 2022; Rousell & Cutter-Mackenzie-Knowles, 2020). These approaches see formal education as a source of the problem itself, in the disconnection it creates between children and the earth, hence the need to reconnect them (Hung, 2022; Bentz, 2020).

Rising global temperatures due to greenhouse gas emissions contribute to changes in climate that have adverse effects on the environment. Adverse weather such as hurricanes, cyclones, typhoons, floods, and storms increases as a result of climate change. Since its inception, world leaders have been strategizing on climate change measures to mitigate these events. They have also been emphasizing the impact that early education and literacy have on climate change. They assert that trained children understand the significance of resources and know how to protect and conserve them (Lamb et al., 2021; Mikhaylov et al., 2020; Shen et al., 2020; Yoro & Daramola, 2020). They claim that literate children have more power to make better environmental decisions. As such, teachers and education stakeholders direct climate change curriculum to young readers by combining basic knowledge of reading and the knowledge of its subjects (Nurwidodo et al., 2020; Suryawati et al., 2020).

It implies, then, that children should understand climate change, learn its science, and advance skills of social and emotional problems that climate change often poses. Early language skills relate to children's abilities to understand complex concepts (Jones & Davison, 2021; Lee et al., 2020). Key skills and concepts linked to the climate crisis must also be addressed by educators. They include being climate change curious, prepared to learn about the climate crisis, concepts that relate to environmental and socio-economic issues that the climate crisis raises, habits and personal actions that support mass climate change-related projects such as recycling, reusing, restoring, and reducing, and respect for other social and cultural perspectives. As details on the climate crisis's educational importance, this study addresses reading problems in primary schools first (González-Pérez & Ramírez-Montoya, 2022; White et al., 2022; Jones & Davison, 2021).

2.1. Integrating Climate Crisis in Literacy Curriculum

Bearing important weight on our value systems and ways of life through shaping our world, the education sector needs to be first in line in mitigating and adjusting for the climate crisis. Criticized for its unsympathetic stance towards the issue, governments are making calls for formal education to adapt to climate change and

raise awareness in a qualitative way (Watts et al., 2021). On the other hand, floods, heat waves, landslides, etc., which are among the various consequences of the climate crisis, are destroying education infrastructures.

It is estimated that students are fond of activities, give importance to the subject, get satisfaction from the subject, and deserve to be given a place in the teaching process through production (Schwartz et al., 2023; Ojala et al., 2021). Such activities contribute to intrinsic motivation. Activities that help children visually and verbally comprehend the impacts of greenhouse gas emissions might be seen as superficial and subject to learning. It is known that there are few teaching processes that involve issues towards the climate crisis. Such activities require students to take part in this learning process with their individual differences by using their prior knowledge related to the issue and deciding in what way to learn (Rapanta et al., 2020; Rousell & Cutter-Mackenzie-Knowles, 2020; Whittle et al., 2020).

All levels of education must be scrutinized in order to raise responsible individuals with knowledge of their ecological responsibility in the fight against the effects of the climate crisis, whose events occurring in different geographical regions are interrelated (Hickman et al., 2021). Earth literacy education aims to raise students who realize and consider ecological truths and the impacts of human activities on the world.

3. Key Developmental Stages and Milestones about Literacy Development in Primary School Students

Individuals' lifelong journey of literacy starts in the first years of life. Preschool-aged children acquire knowledge and fundamental skills that will enable them to start formal education. Hence, literacy education in the first years of school is of utmost importance for both educators and caregivers (Tang et al., 2023; Wang et al., 2020). In the case of primary school students, this issue goes one step further. From a cognitive perspective, this is a period when children's thinking and reasoning skills start to become operational and when children learn the basics of reading and writing. Based on this understanding, a number of studies have indicated the essential premise of literacy acquisition: children who enter primary school with any number of developmental irregularities are thought to experience literacy achievement difficulties (Alatalo & Westlund, 2021).

Early childhood, middle (primary education), and adolescence are considered the key developmental stages and milestones. Each of them has its unique pattern of physical, social, emotional, and cognitive changes. Literacy shifts the focus from just basic reading skills to a more language-based cognitive development approach. Our capacity for environmental literacy begins in these stages. In early childhood, it is about increasing children's sensitivity to the environment and surrounding life forms, such as plants, insects, animals, water, soil, waste, energy, and air pollution. The development of environmental literacy is a process that takes place at different stages of elementary and secondary education (Ardoin & Bowers, 2020; Kamil et al., 2020).

With the current attention, the establishment of environmental literacy has been further integrated with school education. Contradictory views are the ability of a primary school student and public members of the three stages of development. Lacking

application of a more structured approach for primary students, consensus experienced worldwide appeared to dilute a more common and standardized criterion. In addition, literacy studies show that during educational activities, educators should interact with children to develop their concepts and thoughts and promote their relationship and enhanced arguments (Kamil et al., 2020; Queiruga-Dios et al., 2020; Sukma et al., 2020). In the medium term, the environmental educator should be trained. The alumni are expected to engage with students to gain environmental awareness throughout school education. This can be achieved through interactive sessions, field trips, and experiential learning activities. Focusing on key developmental stages and milestones, it is crucial to incorporate climate crisis education into the curriculum at an early age. This will help students understand the urgency of the climate crisis and develop necessary literacy skills. Additionally, integrating climate crisis topics into the curriculum can enhance students' critical thinking abilities and global awareness. Students can develop a deeper understanding of environmental issues and their impact on the world (Eilam, 2022; Kolenatý et al., 2022; Siegner & Stapert, 2020).

4. Challenges in climate crisis Literacy Education for Primary School Students

While climate literacy is widely advocated, critics argue that overcrowded curricula may limit implementation (Holland, 2020). However, interdisciplinary integration (e.g., linking climate themes to existing literacy goals) could mitigate this.

To help students successfully navigate through different literacy aspects of the climate crisis, literacy educators must address a number of challenges. The difficulty in decoding climate literacy information and the difficulty with the mental processes of understanding highly technical and broad societal issues are two key challenges in climate literacy for students (Hahn & Berkers, 2021; Hubbard, 2021). These challenges occur because climate literacy education not only requires teaching students the knowledge of climate crisis, but also requires connecting students to meaning, then to practice and self-reflection. Addressing the practical aspects of the problem cannot be underestimated. School literacy educators need to structure experiences that offer primary school students an opportunity to feel they are a part of change. Only when primary school students feel a sense of purpose and empowerment, can we expect them to successfully solve the impact of climate crisis in their communities (Ayers et al., 2020; Bentz, 2020).

Discussions about complex ideas require neutral and safe learning environments. This is particularly pressing urgency when students are discussing climate change when their ideas have the potential to be confrontational. Climate scientists agree that humans are causing climate change. But when 65% of adults believe that their own behavior is not causing climate change, increasing numbers of educators are expressing concern over a new wave of student resistance. Since such psychology and affective issues can seriously undermine students' learning abilities, literacy educators must play a critical part in helping create a safe environment in which open discussion about climate change can occur (Kotcher et al., 2021; Bouman et al., 2020).

A basic challenge in addressing the impact of the climate crisis is in helping students understand, and symbolically engage in the

issues and partake in debate and argument within and across solo, interactive and societal entities. For example, students have to learn about the relationship between climate and evolving climate conditions, interpret conflicting information in texts, justify arguments with evidence, and also develop self-awareness of personal beliefs, aspirations and side effects on managing risks and benefits to humans and nature of responsibilities from financial support and usage (Kolenatý et al., 2022; Verlie, 2022).

A complete understanding of the scope and purpose of climate literature goes beyond the relatively simple act of identifying vocabulary of a given text. Texts about the climate crisis are interdisciplinary. They relate and integrate information from many scientific disciplines and connect scientific learning to global, national, and local problems in nature, the economy and society (Schipper et al., 2021; Shrivastava et al., 2020). Therefore, addressing literacy education through the impacts of the climate crisis require integration of methods of text discourse, content area textbooks, thematic models, and authentic classroom documents to understand the climate system in earth science. From understanding complex informational text students must move on to problem-based inquiry, argumentation and multimodal responses. Hosts for accessing information include books and government reports, websites, museums, participation in federal hearings, interaction with scientists via videoconference and participation in interactive research cruises or onboard flights from the Antarctic (Hattan & Lupo, 2020; Morton, 2020).

5. Socioeconomic Disparities in Access to climate crisis Literacy Education for Primary School Student

To understand how the climate crisis is affecting the creation of educational services for primary schools, it is important to grasp the positive and negative drivers facing primary schools and primary school children. Positive drivers that now exist include the need to find solutions that help primary school children and that strengthen the resilience of children, the school campus, and the surrounding community, with the school community hard hit by the global economy. The changes also include the need to expand the global K-12 school market, the primary school need for a new purpose for the school campus, the fact that primary school students can act as agents of change to demonstrate climate emergency solutions, and that a significant number of schools have curriculum development needs (Ozden, 2022; Chankseliani & McCowan, 2021; Boulianne et al., 2020; Rousell & Cutter-Mackenzie-Knowles, 2020).

While there are significant benefits in developing appropriate climate emergency educational provisions for primary schools and in socializing children into climate emergency behaviors, the shift to a focus on such provision has the potential to exacerbate current teaching delivery, student literacies, and academic performance issues. These issues include existing student socioeconomic disparities, the digital divide, and the need to ensure that educational offers can be equitably accessed, understood, and acted upon, particularly by children with poorly developed literacy, skills, and perspectives. Primary school teachers are being asked to develop literacy provisions to meet a new audience and community needs. Schools are being asked to go further, with parents encouraged to adapt their teaching skills and literacies to the task in their interactions with their primary school children at home (Reimers, 2021; Whittle et al., 2020).

6. Policy Recommendations for Governments and Educational Institutions for Climate Crisis

The Intergovernmental Panel on Climate Change (IPCC, 2008) identified adverse financial, market, and behavioral barriers to mitigation. Some of the market barriers include little economic weakening of the benefits of mitigation, low expectations about future energy prices, the energy security 'premium' attached to coal and nuclear energies, and attenuation of bottom-up price signals through energy subsidies (Quinn & Buchanan, 2022; Owen & Wong, 2021). The financial hurdle is the challenge faced by actors wishing to invest in low-emissions technologies. However, market return and investments are increasingly influenced by unprecedented developments in market demand-side and supply-side drivers. 'Behavior' is the result of consumer, producer, regulator, and financial actor choices. Financial burdens, through market failure and policy failure, have led to a lack of economic development and incurred large greenhouse-related costs. These growing characteristics and policies to overcome them can offset counter-incentive behavior (Owen & Wong, 2021).

In order to effectively address the impact of climate crisis on education, it is crucial for governments and educational institutions to implement comprehensive policies and initiatives that prioritize the literacy issues of primary school students. This may include investing in teacher training programs, developing age-appropriate curriculum on climate change and sustainability, and ensuring access to updated educational resources. Additionally, governments and educational institutions should prioritize funding for research on the intersection of climate crisis and literacy education (Quinn & Buchanan, 2022). This will help develop effective strategies and interventions to address the literacy issues faced by primary school students in the face of the climate crisis.

It is imperative that governments and educational institutions take proactive measures to integrate climate education into existing literacy programs. This can be achieved through curriculum revisions, teacher training, and the development of educational resources focused on climate literacy (Beck, 2022; Quinn & Buchanan, 2022). In relation to professional learning for teachers, this paper reports the need for prospective and current teachers to have experience in learning about an issue for themselves before they can participate in education that deals with climate change and the climate crisis. In addition, more research is needed on curriculum content and supportive teaching strategies, while it is also necessary to maintain children's learning at the level of their current literacy skills (Quinn & Buchanan, 2022).

7. Conclusion and Future Directions in education for Climate Crisis

We are in an era where a looming climate crisis is predicted to affect everything, including human lives. Though adults and policymakers are relatively aware of the threats, this awareness or knowledge of these issues is not as prevalent in younger and/or more vulnerable sections of our society. Thus, the present approach presents an updated literature review of what we know or what we need to know about the impact of the climate crisis on another vulnerable group - elementary school children. This approach suggests research and policy attention to addressing literacy problems and difficulties reported by primary school students in

the context of the climate crisis, the environment and ecology (Quinn, 2023).

The climate crisis provides us with a unique and pressing opportunity to deeply reflect upon and extensively research potential solutions that could profoundly impact the lives of a whole generation of school children. Specifically, we must pay diligent attention to the critical issue of literacy among primary school students, as this will be instrumental in shaping their understanding and response to the climate crisis (Owen & Wong, 2021). To address this matter comprehensively, several essential areas beckon for further exploration and advancement. Firstly, it is crucial to actively cultivate innovative methods and purposeful tools that empower educators and engage young minds in perceiving and grappling with the multifaceted aspects of the climate crisis, environment, and ecology through children's literature. By doing so, we can not only influence their perspectives but also facilitate constructive dialogue surrounding these crucial topics (McWilliam et al., 2020).

Furthermore, it is essential to formulate comprehensive guidelines that encompass media literacy practices and curricular materials. Such guidelines would focus on effectively navigating the realm of climate crisis reporting, particularly during a time inundated with misinformation and fake news. These guidelines would equip students with the critical skills necessary to discern fact from fiction, empowering them to develop informed opinions and advocate for meaningful change (Owen & Wong, 2021).

Moreover, to ensure maximum impact, it is imperative to integrate climate crisis education seamlessly into existing literacy programs and curricula. By seamlessly weaving the climate crisis into these educational frameworks, we can foster a generation of students who possess an inherent understanding of the urgency and implications of environmental challenges. This integration would allow them to explore the interconnectedness between climate issues and various subjects, inspiring holistic thinking and informed action. In conclusion, the climate crisis provides us with a pivotal moment to address the literacy challenges faced by primary school children (Owen & Wong, 2021).

By actively engaging with this issue and employing innovative approaches, we can effectively equip the younger generation with the necessary knowledge, skills, and perspectives to navigate the complexities of the climate crisis and fuel meaningful change (da Costa Cabral, 2021).

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