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Environmental and Science Education: Addressing social issues and community awareness

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ABSTRACT

This study examines environmental and science education and its associated social issues, identifying global challenges and strategies to enhance learning outcomes. Environmental and science education is essential for developing learners' critical thinking, problem-solving skills, environmental awareness, and responsible citizenship. It enables students to understand complex issues such as climate change, pollution, and resource management while fostering sustainable practices. From an educational anthropology perspective, this field highlights how cultural values, traditional ecological knowledge, and social contexts influence scientific understanding and

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environmental behaviors. Despite its importance, environmental and science education faces ongoing global challenges, including inadequate teacher training, outdated curricula, limited resources, unequal access, and difficulty engaging students in practical learning. Other obstacles include outdated infrastructure, limited interdisciplinary expertise among educators, and a gap between theory and real-world application. Guided by the Transformative Sustainability Learning (TSL) theory, which emphasizes experiential, reflective, and action-oriented learning, this study employed a data mining methodology to analyze scholarly literature, government reports, educational datasets, and international case studies. The findings indicate that improving environmental and science education requires multifaceted strategies. Key interventions include enhancing teacher training, integrating environmental topics into curricula, increasing resource availability, and providing institutional and governmental support. Modern teaching approaches, such as ICT integration, project-based learning, community engagement, and climate change education, were found to increase student engagement, motivation, and practical understanding of environmental issues. Socio-economic equity and inclusive policies are critical to ensuring all students have access to high-quality education and develop environmental literacy. Systematic monitoring and evaluation support continuous improvement and effective resource allocation. In conclusion, a coordinated approach combining teacher development, curriculum enhancement, experiential learning, community involvement, and institutional support is essential for transforming environmental and science education into a tool for sustainability and social change. By addressing educational and social gaps holistically, learners are empowered to become responsible environmental stewards and contribute to sustainable development and societal well-being.

Keywords: Environmental education, Science Education, educational anthropology, sustainability, teacher training, climate change education

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INTRODUCTION

Science and Environmental Education is a field of study that helps learners understand scientific concepts and their connection to the natural environment. It develops critical thinking, problem-solving skills, and awareness of environmental issues such as pollution, climate change, and resource conservation. Science and environmental education give students the information and abilities they need to tackle difficult environmental and social issues including pollution, resource management, and climate change. It encourages sustainable habits and develops critical thinking, problem-solving, and responsible citizenship. Effective learning is hampered by issues like insufficient teacher preparation, scarce resources, out-of-date curricula, and unequal access. Students' understanding of and reactions to environmental concerns are also influenced by social and cultural contexts, underscoring the need for tactics that improve learning outcomes, advance environmental literacy, and enable students to take part in sustainable and social change.

Environmental and science education teaches students about how humans and ecosystems interact and helps them develop critical thinking and problem-solving skills that will help them

live sustainably. It gives learners the tools they need to deal with difficult problems like climate change, pollution, and protecting resources (EPA, 2025).

Environmental and science education is important in educational anthropology because it shows how different cultures interact with their natural surroundings, share beliefs and values about the environment, and develop scientific knowledge based on their cultural perspectives. This focus helps anthropologists' study how environmental education influences cultural practices and values, highlights the role of traditional ecological knowledge, and explores how people learn about nature and science within their cultures (Zidny, Sjöström, & Eilks, 2020).

In educational anthropology, environmental and science education variables are important because they show how social structures, culture, and personal experiences influence environmental behavior and knowledge. By examining various cultural perspectives of the environment, the incorporation of indigenous knowledge in science education, and the impact of social and cultural factors on students' relationships to the natural world, anthropological research investigates these relationships. The field places a strong emphasis on the necessity of comprehending social context in order to create educational programs that support ethical environmental behavior and take into account various epistemologies (Braun, Cottrell, & Dierkes, 2018).

Educational anthropology examines how education relates to social issues like inequality, culture, and identity. It highlights how cultural values shape educational goals and how schooling can both transmit culture and reinforce inequalities. By studying teaching and learning in their cultural contexts, it promotes more relevant and effective educational practices. Environmental and science education within this field explores how different cultures understand nature, transmit environmental values, and shape scientific knowledge, emphasizing the role of traditional ecological knowledge and cultural influences on learning about the environment (Henze, 2020).

Environmental and science education encounters obstacles such as insufficient resources and funding, complicated and daunting subject matter, gaps in teacher training, and challenges in captivating students while closing the knowledge-action gap for behavioral change. Further issues include tackling outdated school infrastructures, such as inadequate ventilation and insufficient green space (Karlsson, & Lindström, 2020).

The numerous challenges that beset environmental and science education in many Asian countries include serious difficulties in integrating complex issues like climate change into school curricula, lack of quality teacher training to teach these subjects, and inequity in access to quality education when disasters related to climate occur. Other challenges include lack of adequate funding and resources, reliance on outdated methods of teaching, and disconnections between theoretical knowledge and the practical dimensions of environmental concerns. These challenges underscore the necessity for practical, skill-based approaches in education (Furihata & Ninomiya-Lim, 2017).

In Europe, scientific and environmental education faces a number of difficulties. These issues include inadequate curriculum integration, inadequate teacher training, and insufficient funding. There is a disconnect between practical application and theoretical comprehension. Due to financial constraints, many European countries—particularly those in Central and Eastern Europe—often prioritize traditional academic subjects. For example, in Slovakia, the success of environmental education often depends on the efforts of individual teachers. Furthermore, educators' general lack of awareness and interdisciplinary knowledge makes it difficult to

successfully integrate sustainability principles into a variety of subject areas (Seikkula-Leino, Jónsdóttir, Håkansson-Lindqvist, et al., 2021).

In Australia, environmental and science education faces a range of challenges, including the lack of explicit climate change content in the curriculum, insufficient teacher training to handle sensitive topics, limited access to resources and support, and declining student engagement. These issues create a gap between the intended objectives of science education and its practical application, as curricula often overlook local and real-world environmental concerns (Eilam, Prasad, & Widdop Quinton, 2020).

Environmental and science education in African countries encounters several challenges, such as insufficient curriculum integration, inadequate teacher preparation, and limited educational resources. Curricula frequently lack local relevance and do not incorporate indigenous knowledge systems. Additionally, many teachers are not adequately prepared to address environmental topics, especially climate change. Persistent underfunding and inadequate infrastructure result in a shortage of instructional materials, laboratory equipment, and opportunities for experiential outdoor learning. These factors collectively impede the development of environmental literacy and scientific competencies among students (Benjamin, & Adu, 2019).

Environmental and science education in North America faces several challenges. These include not having a formal curriculum, not enough teacher training, and limited resources, especially for climate change topics. Lower-income and diverse communities often have less access to environmental education. There is also a gap between teachers wanting to teach these subjects and the support they receive from administrators. Many students feel anxious about climate issues because they think their education is not enough, and some school buildings are not ideal for learning (Ennes, et al., 2021).

Environmental and science education problems in South America include a lack of resources, insufficient teacher training, irrelevant curricula, and educational inequalities. There are also challenges in moving from basic information sharing to fostering critical thinking and integrating ethical and social aspects into environmental education. These issues are worsened by the region's vulnerability to environmental crises and limited access to advanced science and technology (Briggs, Trautmann, & Fournier, 2018).

Statement of the problem

This study examines various approaches to addressing gaps in environmental and science education and their related social issues. Key areas of focus include the impact of adequate teacher training on improving educational quality, the effect of effective curriculum integration on student learning, and strategies to enhance the availability of teaching and learning resources. It also considers the role of institutional and governmental support, promoting socio-economic equity in education, and the adoption of modern teaching strategies, including ICT integration. Furthermore, the study explores the inclusion of climate change education, the importance of community and real-world engagement, methods to foster student motivation and positive environmental attitudes, and the monitoring and evaluation of educational programs. By investigating these strategies, the study aims to understand how they collectively strengthen environmental and science education, making it more effective, inclusive, and responsive to contemporary environmental and social challenges.

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METHODOLOGY

This study used a data mining methodology to systematically analyze literature and datasets to identify strategies for improving environmental and science education and addressing related social issues.

This method allowed the study to gather and analyze a large amount of data from academic publications, official documents, educational datasets, and global case studies. In order to find patterns, connections, and trends in initiatives meant to enhance science and environmental education as well as their social effects, the data were arranged and examined. This provided insights into practical methods for closing educational and societal gaps.

RESULTS AND DISCUSSION

This section presents and discusses the results of the study, drawing directly from the data gathered through the research design and procedures outlined in the preceding methodology chapter. The study employed a descriptive analytical approach to examine key factors influencing environmental and science education and their associated social issues, with particular attention to teacher training, curriculum integration, resource availability, institutional and governmental support, socioeconomic equity, and contemporary pedagogical strategies. Data were derived from systematically reviewed empirical and theoretical sources aligned with the study objectives and were analyzed through qualitative synthesis and critical thematic interpretation. The discussion that follows is grounded in this analytical process and interprets the results in relation to the study's overarching aim of understanding how integrated educational strategies can strengthen environmental and science education while addressing persistent social challenges.

The contextual foundation of the findings underscores the urgent global need to strengthen environmental and science education across educational levels. The analysis reveals that education systems increasingly recognize the importance of integrating environmental sustainability, experiential and location based learning, and critical problem-solving skills into curricula. These elements collectively aim to equip learners with the competencies and dispositions required to respond effectively to complex global issues such as pollution, climate change, and resource depletion. The distribution of themes across the reviewed literature indicates a strong consensus that science and environmental education are not only academic disciplines but also social instruments for fostering scientific literacy, environmental awareness, and responsible citizenship. As Feinstein and Kirchgasler (2015) emphasize, addressing the pedagogical and social challenges inherent in these fields enhances the relevance of education and empowers learners to participate meaningfully in sustainable development and global citizenship.

A major result of the study highlights the central role of adequate teacher training in improving environmental and science education and mitigating related social issues. The findings consistently show that teacher capacity building directly enhances instructional quality by strengthening teachers' subject matter knowledge, pedagogical skills, and confidence in delivering complex environmental concepts. Well trained teachers are more likely to employ inquiry based, learner centered, and contextually relevant strategies that actively engage students and foster higher order thinking skills. These instructional improvements are associated with stronger academic performance, more positive attitudes toward science, and increased environmental responsibility among learners. The results align with the assertions of Dange and Siddaraju (2020),

who argue that teacher preparedness is foundational to enabling students to address multifaceted challenges such as climate change and social inequality through informed and ethical decision making.

The analysis further demonstrates that effective curriculum integration is a critical determinant of student learning outcomes in science and environmental education. The results indicate that curricula that deliberately integrate environmental concepts across disciplines promote deeper conceptual understanding, enhanced critical thinking, and stronger connections between theoretical knowledge and real-world applications. Students exposed to well-integrated curricula exhibit improved problem-solving skills, greater retention of scientific concepts, and higher levels of engagement in learning activities. These outcomes suggest that curricular coherence and relevance play a vital role in making learning meaningful and actionable. This finding supports the work of Xayrullo o'g and Rajabboyovna (2024), who emphasize that integrated curricula enable learners to construct knowledge holistically rather than in fragmented or isolated ways.

Resource availability emerged as another significant factor influencing the effectiveness of teaching and learning in environmental and science education. The results indicate that increased access to instructional resources, including technological tools, community-based materials, and opportunities for project-based learning, substantially enhances student engagement and practical inquiry. Schools that leverage community partnerships, integrate technology, and invest in teacher development are better positioned to provide authentic, hands-on learning experiences that promote environmental awareness and problem-solving skills. The findings suggest that resource rich learning environments cultivate curiosity, competence, and readiness among students to address environmental challenges beyond the classroom. These results are consistent with Rahmawati, Suryani, Akhyar, and Sukarmin (2020), who highlight the role of resource accessibility in supporting inquiry driven and contextually grounded science education.

Institutional and governmental support was identified as an essential enabling condition that amplifies the impact of teacher training, curriculum integration, and resource provision. The results indicate that policy frameworks, funding mechanisms, and institutional incentives play a decisive role in scaling effective educational practices and ensuring their sustainability. Governmental and institutional involvement supports the integration of sustainability into curricula, funds research and innovation, and promotes public awareness through outreach initiatives. Such support structures help translate educational goals into practical and systemic outcomes, fostering sustainable behaviors and innovation at both institutional and community levels. This finding aligns with Bozeman and Youtie (2017), who emphasize that coordinated policy and institutional action is necessary to address complex social and environmental challenges through education.

Socioeconomic equity in education emerged as a cross-cutting theme that significantly shapes the reach and impact of environmental and science education initiatives. The findings indicate that addressing socioeconomic disparities is essential to ensuring equitable access to high quality STEM and sustainability focused education. When barriers related to income, geography, and social background are reduced, students are better able to engage with scientific and environmental issues, participate in citizen science initiatives, and adopt sustainable practices. The results suggest that equity oriented educational strategies contribute to a more informed and environmentally conscious populace capable of driving innovation and advocating for sustainable solutions. This interpretation is supported by Mehmood (2024), who underscores the role of equitable education in fostering inclusive and socially responsive environmental action.

The integration of modern teaching strategies and information and communication technology was also found to significantly enhance science and environmental education. The results indicate that ICT enabled approaches, such as virtual laboratories, simulations, multimedia resources, and gamified learning, create interactive and personalized learning environments that improve student engagement and understanding. These strategies support the development of digital literacy, critical thinking, and systems level understanding of complex ecological processes. Students exposed to such approaches demonstrate stronger problem-solving abilities and a heightened sense of environmental responsibility. The findings corroborate those of Sabri, Ismail, Annuar, et al. (2024), who report that contemporary pedagogies supported by technology increase motivation and deepen conceptual learning in science education.

The inclusion of climate change education was identified as a particularly influential component in shaping informed and responsible citizenship. The results indicate that climate change education enhances climate literacy, promotes sustainable behaviors, and encourages civic and socio-political engagement related to environmental issues. By equipping learners with knowledge, skills, and motivation, climate change education fosters long term thinking, community resilience, and preparedness for emerging green economy pathways. These outcomes support the position of Kundariati, Ibrohim, Rohman, and Nida (2025), who argue that climate education is central to addressing both environmental and societal challenges through education.

Community and real-world engagement further emerged as a vital mechanism for strengthening environmental stewardship and scientific understanding. The findings show that experiential learning opportunities linked to local contexts enable students to connect classroom knowledge with real environmental and social issues. Such engagement promotes deeper understanding, social awareness, and a sense of agency among learners, empowering them to contribute to positive change in areas such as environmental justice and sustainable living. This result aligns with Huang, Wang, Lee, Lin, and Wu (2024), who emphasize the importance of community-based learning in cultivating active and environmentally responsible citizens.

Student motivation and environmental attitudes were also highlighted as key outcomes influenced by effective science education. The results indicate that when students are actively engaged through relevant, inquiry driven, and value-oriented instruction, they develop positive attitudes toward science and a stronger emotional connection to the environment. This motivational dimension supports sustained behavioral change, critical problem analysis, and proactive environmental action. The findings resonate with İnce (2023), who asserts that science education should move beyond content transmission to foster meaningful engagement and responsible citizenship.

Finally, the study underscores the importance of systematic monitoring and evaluation in ensuring the effectiveness of environmental and science education programs. The results indicate that robust monitoring and evaluation processes help identify effective practices, guide resource allocation, enhance curriculum relevance, and promote accountability and continuous improvement. Through evidence-based refinement of educational strategies, monitoring and evaluation contribute to the development of environmentally conscious and socially engaged learners capable of addressing complex global challenges. This finding supports the conclusions of Muhayimana and Kamuhanda (2020), who highlight the role of evaluation in sustaining educational quality and impact.

In synthesis, the results of the study reveal a coherent and interrelated set of factors that collectively strengthen science and environmental education and address associated social issues.

Curriculum integration, resource availability, and teacher capacity building emerge as primary drivers of improved student learning, engagement, and environmental stewardship. These are reinforced by institutional and governmental support, socioeconomic equity, ICT integration, climate change education, community engagement, and systematic monitoring and evaluation. Together, these elements create synergistic effects that enhance relevance, inclusivity, and sustainability in education. The findings demonstrate that a coordinated and multi-dimensional strategy centered on teacher development, modern pedagogy, inclusive policy, and continuous assessment offers the most effective pathway for transforming science and environmental education into a solution focused force for long term, equitable, and sustainable social change.

CONCLUSION

The findings of this study demonstrate that the strengthening of science and environmental education is fundamentally anchored in effective teacher preparation, relevant and well-integrated curricula, adequate resource provision, and inclusive learning environments. The results consistently show that when teachers are equipped with strong content knowledge and appropriate pedagogical skills, they are better able to deliver instruction that promotes critical thinking, environmental awareness, and responsible citizenship among students. Meaningful curriculum integration further enhances these outcomes by linking scientific concepts with real world environmental issues, thereby deepening student understanding and engagement. The availability of instructional resources and the use of innovative teaching strategies, particularly those supported by information and communication technology, were likewise found to play a crucial role in improving the quality and relevance of learning experiences. Together, these factors contribute to the development of learners who are not only scientifically literate but also environmentally conscious and socially responsible.

The study also highlights the importance of institutional and governmental support in sustaining and scaling effective educational practices. Supportive policies, sufficient funding, and equitable access to educational resources enable schools to implement innovative programs and address disparities that limit participation in high quality science and environmental education, particularly in marginalized contexts. Community involvement further strengthens these efforts by connecting classroom learning to authentic environmental challenges and social realities, thereby reinforcing students' sense of agency and responsibility. The findings emphasize that continuous monitoring and evaluation are essential in ensuring that educational initiatives remain responsive, effective, and adaptable to emerging environmental and social concerns. Through systematic assessment, successful practices can be identified, refined, and sustained over time.

Overall, the conclusions of this study are consistent with the Transformative Sustainability Learning Theory, which emphasizes action oriented, experiential, and reflective learning as mechanisms for transforming learners' attitudes, behaviors, and sense of responsibility toward sustainability. The synthesis of findings suggests that an integrated and holistic approach grounded in this theoretical framework can position science and environmental education as a powerful driver of social change and sustainable development. In light of these conclusions, the study underscores the need to strengthen teacher training programs and curriculum integration to ensure that learning is both meaningful and practical. It also affirms the importance of continuous professional development, the incorporation of sustainability and climate related topics across subject areas, and the strategic use of modern teaching approaches supported by ICT. Furthermore, sustained governmental and institutional commitment is necessary to provide adequate funding,

establish enabling policies, and promote equitable access to resources. Enhanced collaboration with communities and environmental organizations, coupled with regular monitoring and evaluation, is essential to ensure continuous improvement, accountability, and long-term responsiveness to environmental and societal challenges.

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