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The interplay of environmental education, investment in education, and environmental innovation: Pathways toward sustainable development

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ABSTRACT

Environmental concerns and criticism of economic and industrial expansion gave rise to the concept of sustainable development, which aims to meet the demands of the current generation while preserving resources for future generations. Significant changes in community life at all levels are necessary for sustainable growth. Citizens and civil society must be involved in this change, and education and understanding of sustainable development are prerequisites. Without universal access to education and raising human awareness, sustainable development would remain a shallow and obscene catchphrase. Education is the foundation of our modern world's progress. The purpose of this study is to review the studies about the importance of environmental education due to environmental educational investment and environmental innovation. The results indicate that human resources development will be the key to sustainable and all-encompassing development and that investing in human resources through education, particularly environmental education, which is a fundamental component and pillar of any society, is a necessary condition for any development to occur and continue. Widespread, ongoing, all-encompassing, and inclusive actions are required to raise environmental awareness because education is one of the most important aspects influencing each nation's sustainable development.
Keywords: environmental education, educational investment, environmental innovation

1. INTRODUCTION

Global environmental protection initiatives have been severely strained by rapid economic expansion, underscoring pressing needs in sectors including energy transitions, pollution reduction, and resource efficiency (Lu et al., 2025). Global warming, climate change, excessive pollution, forest depletion, and other issues are posing serious dangers to the planet today (Sharma et al., 2023). Environmental problems brought on by people acting in their own self-interests have a negative impact on society at large (Igei et al., 2024). In line with the rise of individualism, the excesses of the capitalist world, and the abuse of nature, there are environmental crises due to human activity, including but not limited to environmental changes and ignorance of environmental issues (Mousavi et al., 2024). Therefore, it is imperative that we address the current situation and this issue by raising environmental consciousness and teaching the next generation about protecting the environment and the world (Sharma et al., 2023). The tragedy of the commons, which refers to the abuse of common goods and the deterioration of shared resources because of people's self-interests, is at the heart of our environmental problems (Igei et al., 2024). Furthermore, cultural weakness and a lack of awareness about the link between humans and nature are also contributing factors to environmental disasters (Mousavi et al., 2024). Thus, to lessen the effects of climate change and move civilizations closer to a sustainable future,

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comprehensive steps are required (Yang and Fang, 2024). To address these challenges, it is imperative that the culture of environmental preservation be strengthened (Mousavi et al., 2024).

Yazdani et al. (2023) mention that sustainability in the education sector is a broad concept that can be approached as "education for sustainability," which focuses on implementing policy guidelines, or "sustainability of education," which is understood to consider social, economic, technical, and environmental concerns. Sharma et al. (2023) stste that environmental education is essential for enacting significant changes in people's attitudes, actions, and decision-making processes as well as for helping them have a healthy relationship with the environment. A crucial initial step in solving many environmental issues is altering people's beliefs and customs, which in turn leads to changes in behavior (Jaime et al., 2023). Research suggests that information-related interventions, such as educational campaigns, might be effective tools for encouraging behavioral changes in individuals (Salazar et al., 2024). Reducing carbon emissions is the main goal of the low-carbon economy idea, which is essential to attaining sustainable development. Education spending is required for this shift to develop and implement measures such as the adoption of renewable energy, improved energy efficiency, and sustainable production processes (Yang and Fang, 2024). Environmental education is regarded by many scholars as a crucial instrument for preserving the wellbeing of the world's ecosystems (Whitburn et al., 2023). Numerous scholars have noted that environmental education helps to foster positive attitudes and perceptions of nature by giving individuals particular information to assist them better comprehend the causes and effects of environmental concerns (Salazar et al., 2024). One of the most important ways to solve this issue is through environmental education. It equips people and communities with the information and abilities necessary to comprehend, value, and safeguard the environment (Yang and Fang, 2024).

Since the 1960s, the notion that education can serve as a means of disseminating knowledge and promoting environmental protection has gained traction (Van de Wetering et al., 2022). Programs for environmental education are widely available and have gained popularity since the 1970s as a component of both official and informal education (Whitburn et al., 2023). Perkins (2024) mentions that the question of how education affects sustainable development was brought up in the late 1980s. However, according to Díaz-Lopez et al. (2023), scientific publications and concerns regarding socio-economic and environmental issues began to appear in the middle of the twentieth century.

One of the main objectives of environmental education is environmental literacy, according to the government of Canada's website (2025). It describes the ability to understand and evaluate critically the complex interactions among ecological systems, human activity, and climate change. Understanding climate science, environmental dynamics, sustainable practices, and the moral and social implications of environmental issues are all components of environmental literacy. Increased literacy enables people to take responsible actions and make well-informed judgments. Because it prepares people to participate more effectively in creating and contributing to solutions, this educational work is essential. Additionally, it will train the workforce and citizens of the future to be resilient, creative, and responsive.

Development is a comprehensive process for creating new capabilities and capacities in all areas. Every event in the context of development requires a change in perspective and the creation of new human capacities. Therefore, development and compliance with its environmental aspects are carried out by humans, and this is the reason for the importance of investing in education. This education is carried out at the individual and organizational levels. The individual level includes all students (schools, colleges, and universities) and the public. Therefore, environmental education is one of the influential components in development in this study. The purpose of this study is to review the studies about the importance of environmental education due to environmental education investment and environmental innovation.

2. LITERATURE REVIEW

2.1 Environmental education

One conservation tactic that fosters these kinds of synergistic environments is environmental education, which makes it easier for scientists, policymakers, local residents, and other stakeholders to come together (Ardoin et al., 2020). Information-based treatments of this type encourage environmentally friendly behaviors that reduce the negative effects of human activity on the environment (Salazar et al., 2024). It arises from a lack of understanding of the causes of these effects, which results in an inadequate understanding of the scope of these difficulties (Díaz-Lopez et al., 2023). Encouraging cooperative conduct is essential to preventing such negative outcomes, and this may be accomplished by educational strategies like environmental education in addition to institutional designs that promote collaboration (Igei et al., 2024). Numerous scholars have contended that more environmental literacy and awareness will benefit sustainability and the development of new values (Sharma et al., 2023). In addition to teaching people the value of altering their behavior, environmental education also promotes the development of personal norms, which have been demonstrated to produce long-lasting shifts in pro-environmental behavior, even in areas other than those

that are the focus of the program (Salazar et al., 2024). Accordingly, education is essential for promoting social engagement with sustainability issues (Díaz-Lopez et al., 2023). One way to address the serious crisis brought on by excessive and human-induced consumption of natural resources is through environmental education. According to several studies, environmental education has had observable results like better air quality, waste segregation, and waste recycling (Sharma et al., 2023). In order to achieve a sustainable future, environmental education is essential since it cultivates a feeling of environmental responsibility and encourages sustainable practices (Yang and Fang, 2024). Being connected to nature is seen to be a key factor in helping people improve their long-term, transformative environmental behavior (Whitburn et al., 2023). It can be more comprehensive and an integrative approach that addresses emotional reactions and touches on other areas, enabling students to solve environmental and social issues. It is truly transforming (Sharma et al., 2023). A person's subjective perception of their relationship with nature is referred to as their "connection to nature," which can be thought of as a values-based mindset (Whitburn et al., 2023). According to environmental education, people can coexist peacefully with the environment and, as a result, make thoughtful decisions that take future generations into account (Mousavi et al., 2024; Sharma et al., 2023). Wang et al. (2024) state that sustainability education is essential for increasing public awareness of the problems caused by climate change and environmentally friendly solutions, which can have a big impact on managing and avoiding the resource curse. As a result, greater focus is required on the advancement of environmental education through various strategies that contribute to the creation of sustainable development, such as incorporating it into the curriculum or working with other countries (Arya et al., 2024; van de Wetering et al., 2022).

People's education regarding environmental issues has a significant impact on their behavior in the future. While education is crucial to achieving the sustainable development agenda (Díaz-Lopez et al., 2023; Arya et al., 2024), increasing individual literacy and competence also helps to expand energy citizenship, which refers to people's active participation (Igei et al., 2024). Accordingly, as one's value system is deeply rooted in environmental orientation, teaching these values through suitable environment education is possible (Sharma et al., 2023).

Environmental education, according to Ardoin et al. (2020), focuses on outcomes at different scales, such as the ecosystem level (e.g., number of endangered species), the societal level (e.g., community capacity-building), and the individual level (e.g., an individual's environmental attitudes or behavior).

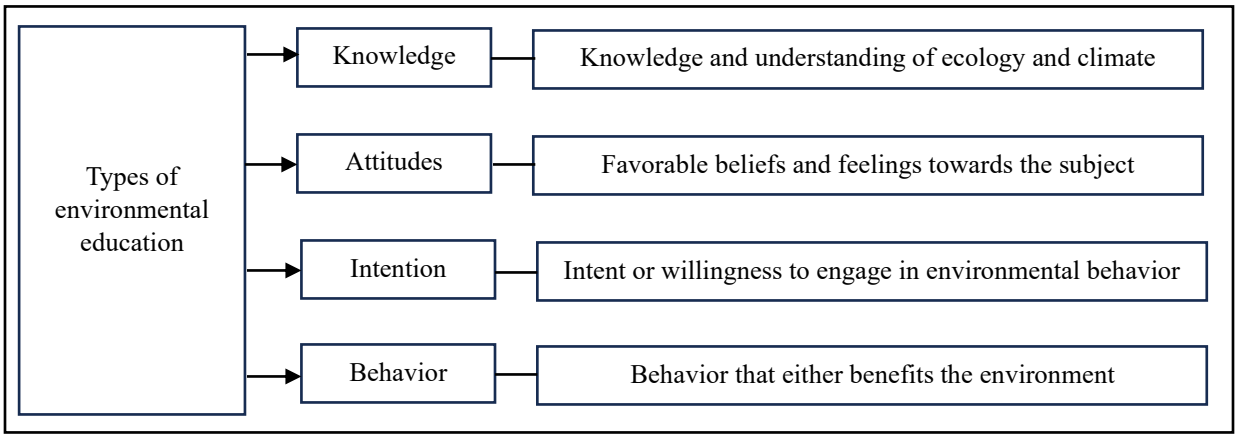

Fig. 1: Types of environmental education

Regarding environmental education, the following knowledge categories are discussed: 1) environmental knowledge comprises factual knowledge and comprehension of ecology, climate, and associated natural scientific ideas and principles, 2) environmental attitudes include positive sentiments and opinions regarding environmental education or the significance of environmental sustainability in general are examples of environmental attitudes. 3) environmental intentions include the desire or willingness to engage in environmental behavior. 4) environmental behavior conduct includes actions that either help the environment or cause the least amount of harm to it. Figure (1) shows the types of environmental education. Environmental education is a type of organizational and human capital, which is the collection of abilities, skills, and information that a person or organization has to employ in a sustainable future. Ardoin et al. (2020) explain that environmental education is defined as methods, resources, and initiatives that foster and support ecologically relevant attitudes, values, awareness, knowledge, and skills in order to equip individuals to take responsible action for the environment. Key elements of sustainable development include: 1) the role of education in promoting sustainable development; 2) the contribution of an educated workforce to production processes; and 3) the preference of educated households for energy efficiency (Wasif Zafar et al., 2020). Human capital is a key

component of economic development, according to the literature on economic growth. Different variables drive human progress, including education, skilled labor, knowledge, and creativity. But the only thing that gives us the tools to understand reality is education. Human development greatly lowers the costs of technology adaption and deployment. Researchers discovered that companies with a high percentage of educated workers have lower environmental expenditures. Researchers contended that raising awareness of environmental issues through education contributes to a higher share of renewable energy, which lowers CO2 emissions (Wasif Zafar et al., 2020).

2.2 Educational investment

One of the main factors propelling environmental innovation and sustainability is environmental education. The investment in environmental education is one of the key elements that significantly affects the innovative activities of economies and enterprises. Carvajal and Popovici (2021) state that education is a type of human capital, which is the collection of a person's abilities, skills, and endowments. As a result, education plays a vital role in creating a sustainable environment and is the primary component of human capital in economies that are globalized (Wasif Zafar et al., 2020). Many of these abilities are not innate; rather, they are developed through investments, which include making decisions about initial costs and weighing current and future advantages (Carvajal and Popovici, 2021). Wasif Zafar et al. (2020) mention that a lack of education in societies is the cause of environmental issues.

As an early reaction to the need for greater support for environmental learning, the ECCC announced an investment of $12.5 million, funded in an innovative partnership with the philanthropic sector, to help promote environmental literacy across Canada, according to the government of Canada website (2025). The financing cycle is one of the first important actions the Canadian government has done to promote environmental education and assist local efforts to do the same.

Research has indicated that funding for higher education can yield favorable outcomes (Simanaviciene et al., 2015). More precisely, when it comes to energy efficiency and environmental awareness concepts, the importance of education in society's human development process cannot be denied (Wasif Zafar et al., 2020). In any case, people invest to get more education and get larger rewards in the long run through real productivity gains or confirmation that such productivity exists. Rates of return are present in all investment projects, whether they use human or non-human resources (Carvajal and Popovici, 2021). Researchers discovered a correlation between energy use and human capital, and they proposed that using human capital in the industrial process could lower energy use. Researchers also found that nations with high levels of human capital also had low per capita energy use. Researchers also suggested that human capital offers the knowledge required to comprehend environmental and energy security challenges (Wasif Zafar et al., 2020). Environmental quality is enhanced by educational advancements. Higher levels of education raise people's knowledge of environmental issues, which lowers emissions. Environmentally friendly technologies that further lower carbon emissions are also supported by high educational attainment (Wasif Zafar et al., 2020).

2.3 Environmental innovation

Given the numerous advantages that environmental innovation offers to sustainable development and the green economy, it is crucial to accurately identify the elements that influence environmental innovation (Zhou et al., 2021). Bothongo and Kinyar (2025) mention that environmental innovation is the creation, use, or exploitation of a good, service, production process, organizational structure, management, or business method that is new to the company or user and that, over the course of its life cycle, reduces environmental risk, pollution, and the negative effects of resource use (including energy use) in comparison to pertinent alternatives. Reducing carbon emissions in the operations of different firms is thought to be fueled by environmental innovation, which includes the creation of new goods, procedures, or practices that have a less environmental impact (Al Amosh, 2025). Bothongo and Kinyar (2025) state that environmental innovation leads to two kinds of externalities: environmental spillover and knowledge spillover. Even though eco-innovation has several advantages, some investors find it unappealing due to its twofold externality (Bothongo and Kinyar, 2025). Lu et al. (2025) posited that environmental innovation offers a viable strategy to balance environmental preservation with economic growth, promoting sustainable development while reducing negative environmental effects.

3. RESEARCH METHODOLOGY

The purpose of this study is to review the studies about the importance of environmental education due to environmental educational investment and environmental innovation. Figure (2) shows the areas in this study.

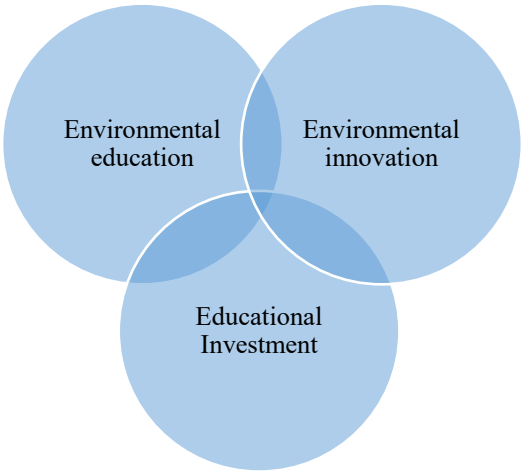

Fig. 2: Study areas

4. CONCLUSION AND SUGGESTIONS

Without a doubt, educating individuals is a national investment that any country that makes more efforts in this direction will be able to enjoy economic, social, and cultural growth and development in the future. Paying attention to the environmental issue requires a continuous and long-term perspective, and improving the damage caused by humans to the environment will improve in the long term, and this perspective must be passed on to future generations. The purpose of this study is to review the studies about the importance of environmental education due to environmental education investment and environmental innovation.

A key factor in raising public understanding of climate change issues is sustainable education. Sustainable education gives people the skills they need to understand the intricacies of climate change by including environmental science principles, the effects of climate change, and sustainable solutions into academic programs. By transferring knowledge, choices, and attitudes that may foster an emotional connection to the environment, environmental education has the power to transform and inspire positive behavior change. Since most research support the idea that environmental education can help reduce the negative impacts of environmental issues, protect the environment, and encourage eco-friendly behavior. Furthermore, noting the overwhelming success of environmental education implementation also depends on the facilitation of environmental education by educators, administrators, universities, and support networks. Environmental education gives young people the opportunity to recognize their responsibility to the environment and develop into more environmentally conscious citizens. Green consumption, which is defined as making well-informed decisions that give preference to goods and services that are environmentally friendly, has become increasingly popular. The ecological burden on our earth can be considerably lessened by educating people about how their consumption patterns affect the ecosystem and encouraging eco-friendly substitutes.

Given that this study addresses the importance of environmental education, it is suggested that future research should consider the method of education at individual levels for students (schools, colleges, and universities) and the public, as well as organizations.

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