World Journal of SDGs Review
Vol.3 (2026), Pp.79-104
ISSN (Online): 3105-4463, ISSN (Print): 3105-4455
DOI: https://doi.org/10.71016/wjsdgr/7tbfa756

Review Article **https://hnpublisher.com**

The Role of Green Education and its Contribution to Achieving the Sustainable Development Goals: A Systematic Review

Muhammad Yousaf[1], Ahmed Ali Qureshi[2], Abdul Khaliq Shaheen[3], Muhammad Shuaib[4]

[1]Department of Education, Mohi-Ud-Din Islamic University Nerian Sharif, Azad Jammu and Kashmir, Pakistan
[2]Assistant Professor, Department of Management Sciences, Shaheed Zulfikar Ali Bhutto Institute of Science and Technology (SZABIST), Islamabad Campus, Pakistan
[3]Department of Education, Mohi-Ud-Din Islamic University Nerian Sharif, Azad Jammu and Kashmir, Pakistan
[4]Assistant Professor, Department of Education, Mohi-Ud-Din Islamic University Nerian Sharif, Azad Jammu and Kashmir, Pakistan
Correspondence: muhammadmubeen534@gmail.com[1]

ABSTRACT

Aim of the Study: The aim of this research article was to explain the importance of sustainable development goals (SDGs), it is becoming a cornerstone of everyday activities and decision-making. This study explores the possibility of how green education can contribute to the SDGs.

Methodology: The research method used in this study was literature review, following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) as a guideline to achieve the research questions (RQs). This research study revealed based on recent studies that green education has many ways to contribute to achieving the SDGs. Based on results/ findings of previous research papers looking into the connection of green education and sustainability.

Findings: The present research study examined the key role of green education which was the creation of a cultural shift and behavioural change in society, which is achieved by raising awareness about climate change on a larger scale.

Conclusion: The study concluded that green education has the potential to become more effective to attain SDGs. But, to make this happen could be difficult with the huge environmental and climatic changes that are predicted over the next few years. In this context, the study highlighted the obstacles to the effects of education and offers a set of lessons and implications for further research in this area.

Keywords: Green education, Environment, Sustainability literacy, Sustainable development goals.

Article History

Received:
August 29, 2026

Revised:
October 21, 2026

Accepted:
October 26, 2026

Online:
October 30, 2026



© 2026 The authors, under a Creative Commons Attribution-NonCommercial 4.0

1. INRODUCTION

In particular, the future of the planet, is largely reliant on humanity's ability to meet the SDGs successfully (Moallemi et al., 2020). Toxic use reduction, outdoor and place-based education, environmental education, and green education (GE) are among the key areas to consider and have been increasingly acknowledged as crucial, in achieving the SDGs (Serafini et al., 2022). It is agreed that the role of GE in breaking the cycle of Hereditary or familial poverty and ensuring the protection of the milieu so that it can continue to serve current and future generations is broad (Grosseck et al., 2019).

Green education gradually evolved and expanded in term of concept and scope especially then the Earth Summit in Brazil in 1992. It is in this summit that the importance of Education for Sustainable Development (ESD) as a way to balance economic and human wellbeing through education was recognized as part of Agenda 21 (Grosseck et al., 2019). At its outset, ESD aimed to incorporate triple bottom line facet into the life-long erudition journey of human race. But, ESD is not just about acquiring and producing knowledge; it also encompasses various aspects of development and progress (Serafini et al., 2022).

Thus, ESD is a fundamental approach for cultivating the knowledge, skills and values necessary to tackle the future sustainability challenges and contribute to the commitment of constructing sustainable societies (Paul, 2019). According to the United Nations Educational, Scientific and Cultural Organization (UNESCO), ESD is “education that empowers learners to make informed decisions and take responsible action for the integrity of the environment, the viability of economies and a just society for the benefit of the present and future generations, in order to respect cultural diversity.” There are three key components of ESD: erudition upshots, training material and instruction. It is designed to empower pupils to reflect and perform autonomously, and to become active participants in tackling sustainability issues.

Moreover, ESD has helped to create trailblazers, and game-changers in lieu of submissive patrons (Varela-Candamio et al., 2018). It allows for citizens to advocate for environmental and social issues in their communities, in their family, and in their organizations. In general, GE shows a crucial character in contributing to environmental protection, communal and monetary advancement and additional facets of lifespan. This is the newness of the present research.

GE, correspondingly known as eco-friendly tutelage or ecopedagogy is an educational strategy aimed at imparting knowledge on environmental problems, environmental principles and sustainable practices (Ardoin et al., 2020). It aims to educate the public about significant environmental issues, such as climate change, biodiversity loss, pollution, and resource depletion, and stresses the importance of preventive actions to address these issues (Shin et al., 2022). Green education is the basic goal of spreading awareness, strengthening knowledge and motivating people to take action in the interest of protecting the environment, maintaining sustainable development and responsible human activity in the environment. It motivates people to engage in environmentally friendly practices and habits, join environmental community projects, promote policy changes, and make eco-conscious choices (Ramírez Suárez et al., 2023).

GE plays an important part in enlightening ecological conscious and liable inhabitants, equipped to handle current and upcoming eco-friendly issues. It helps people to develop knowledge, awareness and responsibility to be able to contribute to creating a sustainable and resilient society. The fundamental principles and goals of green education are shared with those of education for sustainability, particularly the education of industries, communities and individuals who integrate sustainability principles into their activities to make them more sustainable.

Another related concept to nature-based learning is nature-based learning experiences and processes, which highlights the role of nature in learning experiences and learning processes (Jordan & Chawla, 2022). In a broader sense, it is noted that education has a significant impact on building sustainability literacy, which helps people to understand and engage with sustainability-related issues (Kuehl et al.,

2023). In this context, GE sprightly helps in building ecoliteracy, as it lays the foundation for understanding the principles of sustainability and the UNSDGs.

To conclude, sustainability literacy, cleaner production, education for sustainability, GE and nature-based learning are all interconnected conceptions that can all be used to support the achievement of the SDGs. The concepts presented in the present article are used throughout for establishing conceptual ground. The article has seven sections. The role of GE in attaining the SDGs is briefly introduced in the introduction. The second portion is literature review from previously published articles. Criteria (inclusion and exclusion criteria, using PRISMA as a guideline) applied for identification of pertinent review on the function of edification in meeting the SDGs are explained in the methodology fragment. The forth section describes results/findings of the literature review, the fifth section conclude the research article, the sixth and seventh section of the research article has discussed recommendations and further research on the research topic respectively.

1.1. Statement of the Problem

Green education has become a growing phenomenon to promote environmental awareness, sustainable practices and responsible attitude towards the environment. It helps learners develop knowledge, skills, values and attitudes to respond to the environmental challenges, such as Climate Change, Pollution, Biodiversity loss, and unsustainable use of natural resources. Education for Sustainable Development (ESD) has been identified as one of the key ways to nurture sustainability skills and thus empower people to take part in sustainable development (UNESCO, 2017). Moreover, the UN (2015) identifies education as a key element of the global sustainable development agenda and explains that the Sustainable Development Goals (SDGs) are all interconnected.

The concept of green education has been gradually gaining popularity as an enabler of sustainable development, yet the role of green education in attaining SDGs is still significant. Particularly, it is required to draw together existing body of knowledge on linkages of green education with sustainable education and achievement of various SDGs. UNESCO (2017) underscores the centrality of education as a key element within all the 17 SDGs, including the promotion of knowledge and skills, as well as the development of values and attitudes, that will help learners make informed decisions and take responsible action. The contribution of green education to each SDG and the types of educational approaches and implementation problems and opportunities that this contribution entails should be further explored, however.

Hence, this literature review aims to bring together the current research regarding GE and its function in realizing SDGs. It seeks to define the conceptual aspects of the concept of education for sustainability, explore the function of GE in ecological growth, and propose educational stratagems that can help realize sustainable education and practices. The review aims to compile relevant literature to achieve the integrated understanding of the potential of the green education to support the SDGs.

1.2. Research Questions (RQs)

1. What are the vital conceptual aspects of green education acknowledged in the current literature?
2. Via what procedure does green education accelerate to the attainment of the Sustainable Development Goals?
3. What key barriers and prospects impact the consolidation of green education into educational strategies for sustainable development?

1.3. Importance of the Research

The importance of this literature review is that the link of the research that has been conducted on the importance of green education and its role in achieving SDGs is synthesized. While green education has been gradually gaining increasing interest, the current research results are scattered across environmental,

educational, social and economic aspects. In this review, these perspectives are blended to identify the main contributions of green education to the SDGs, methods used to teach students about sustainability, research trends in the green education field and gaps in the literature. It provides a broader view of the potential for green education to shape sustainability knowledge, values, skills and responsible behaviours and contribute to the achievement of various SDGs. The review can also be helpful for researchers, educators, curriculum developers, policy makers, educational institutions, and suggest directions for future research and education for sustainability.

This research is significant because it brings together the existing research and knowledge regarding the function of GE in SDGs. It can enable teachers to incorporate sustainability concepts into their curricula; inform policymakers in developing sustainability-focused educational policies; and help identify gaps in the existing research. Moreover, the review gives guidance to future researchers to study the effectiveness of green education, barriers that face its implementation and its role in environmental, social and economic sustainability.

2. LITERATURE REVIEW

Green education is increasingly recognized as an important pathway for integrating sustainability principles into formal education systems and, consequently, supporting the broader achievement of the SDGs (Akinsemolu & Onyeaka, 2025). Studies by (Varela-Candamio et al., 2018; Venkataraman, 2009) have emphasized the significance of the green education concept. It provides students and educators with appropriate resources and learning environments that enable them to critically examine global environmental challenges and explore possible solutions (Bajaj & Chiu, 2009). Moreover, green education extends beyond a pedagogical innovation and serves as a strategic approach that connects classroom learning with wider institutional reforms. From this perspective, green education involves not merely a pedagogical adjustment but a whole-institution transformation encompassing governance, research agendas, and organizational culture (Mader et al., 2013).

There is a complex and multidimensional link between education and sustainable development. Basic education and the importance of this for the attainment of SDGs at national and international level are emphasized. A knowledge-based economy, in which progress is not only driven by technological development but also by local innovation and creativity, is a particular focus of interest in the field of education, research and lifelong learning. Education for sustainable development then should be conceived as a process of lifelong learning, continuing and extending the concepts of education until they are placed throughout subjects and disciplines, and wherever possible, find their way into the very fabric of the curriculum.

Additionally, Murray, (2012) points out the range and depth of sustainability and suggests it's impractical to expect people to know everything. Rather, he calls for a more balanced approach that incorporates a holistic perspective on sustainability and specialized knowledge in fields that are more relevant or that involve engagement in a more personally significant way (Murray, 2012). This view highlights the role of interdisciplinary education for providing the learner with the opportunity to grasp interconnected sustainability challenges, alongside building specialised knowledge and skills. High-performing universities seem to have well established institutional capacity for sustainability, given that they consistently maintain high performance at multiple assessment methods. Universities in the middle range show higher performance variance, indicating that the sustainability outcomes of the future may not be so much a result of their institutional structures as of their institutional governance mechanisms and strategic directions and the extent of embedding sustainability in their institutional systems. (Sahin, 2025).

2.1. Concept of Green Education

The synthesis of the designated studies revealed that GE is widely conceptualized as an educational approach aimed at developing the knowledge, skills, and values necessary to build a sustainable future (Mallett et al., 2012). It provides educators with practical learning frameworks that connect scientific

knowledge, technology, and social systems with real-world contexts. Furthermore, green education equips individuals with the knowledge, competencies, values, and attitudes required to contribute to a sustainable future (Venkataraman, 2009).

GE involves incorporating key sustainability bottlenecks / constraints in teaching and learning, along with calamity menace decline, ecological ingesting, global warming, economic empowerment, and biological diversity conservation. The peer-reviewed/ refereed literature also highlights the importance of participatory teaching and learning approaches that empower and motivate learners to adopt sustainable behaviours and take meaningful action (Ibezim, 2013). Through these approaches, green education promotes essential skills and aptitude like critical and creativity, synergy in consensus-building, and responsible action. Its implementation, therefore, requires substantial changes in conventional educational practices.

The reviewed studies further indicate that GE plays a significant function in promoting a ecological society and is relevant across all levels of formal education and training, as well as informal and non-formal learning environments (Juntunen & Aksela, 2014). Its scope extends beyond addressing present needs to include the protection and enhancement of quality of life for both current and future generations (Vare & Scott, 2007). In the context of sustainable development, green education can thus be understood as a process through which individuals acquire the knowledge, skills, values, and experiences necessary to participate in individual and collective decision-making at local and global levels, thereby improving present living conditions without compromising the planet's ability to sustain future generations (Ekwueme et al., 2016).

The reviewed studies also suggest that no single pedagogical approach is universally suitable for green education. Instead, the literature emphasizes the need to move towards active, participatory, and experiential learning methods that engage learners and enhance their understanding, critical thinking, and capacity for action. Five key pedagogical elements were identified as particularly relevant to incorporating green education into learning environments: critical reflection, systems thinking and analysis, participatory learning, creative thinking, and collaborative learning (Vare & Scott, 2007).

Critical reflection can be facilitated through conventional lectures as well as learner-centered activities, such as reflective journals, discussion groups, and reflexive accounts (Machost & Stains, 2023). Systems thinking and analysis involve the use of real-world case studies, critical incidents, stimulus-based activities, campus initiatives, and project-based learning to help learners understand the interconnected nature of sustainability challenges (Huckle & Wals, 2015). Participatory learning emphasizes peer interaction, group activities, experiential learning, action research, and dialogue. It may also involve collaborative decision-making and the development of case studies in partnership with industries and community organizations.

Creative thinking can be encouraged through role-playing, problem-based learning, open-ended learning activities, and future-oriented visioning exercises. Collaborative learning, in turn, involves co-inquiry, teamwork, work-based learning, and contributions from guest speakers to facilitate shared knowledge construction and collective learning. Collectively, these pedagogical approaches support the integration of green education principles into educational settings and encourage learners to engage actively with sustainability-related challenges.

2.2. Contribution of Green Education in Attaining SDGs

The overview showed that the instruction of green learning offers teachers along with students a proper educational resources and curricula that emphasize a comprehensive and critical understanding of global environmental issues and how to address them (Bajaj & Chiu, 2009). In addition to all that, there are many advantages that teachers, students, parents and the community can enjoy by attending green schools. This encompasses positive health outcomes, better academic achievement, reduced operating costs, reduced carbon emissions, water savings, and unique learning experiences.

The introduction of green education and eco-friendly learning area helps to improve the health by improving the indoor environment and improving the air quality (Jickling & Wals, 2008). A number of green schools include the more effective use of daylighting and ventilation systems and the use of more environmentally friendly building materials, such as low- or zero volatile organic compound (VOC) paints and carpets, which make the schools healthier for the students and staff (Jickling & Wals, 2008). GE contributes to SDG 3. Ensure healthy lives and promote well-being for all by fostering healthier living and learning environments, which benefits teachers, students and communities.

Green education will benefit SDG 4 by enhancing student learning outcomes (SLOs) and quality education, in addition to supporting SDG 3. SDG 4 seeks to ensure inclusive, equitable and quality education and promote lifelong learning opportunities for all. Having poor indoor air quality can inhibit this goal, since students' ability to concentrate and focus can be compromised. The reviewed studies show that students' test scores can improve significantly if they are educated in green classrooms that feature better daylighting, acoustic conditions and cleaner carpets and paints, which release fewer toxic substances indoors (Jickling & Wals, 2008).

The results are of special significance to SDG 4 (Inclusive and equitable quality education and lifelong learning opportunities for all). Although the right to education has been extended, many issues remain with regard to quality and completion of education. If current trends in progress continue, for example, more than 22 million children in 43 countries would not have access to pre-primary education. Likewise, education does not ensure quality learning or success in attainment of the education objective. There are about 103 million youth without basic literacy skills worldwide, of whom 60% are girls. Furthermore, over 50% of children in one-fourth of the world's countries do not meet minimum achievement levels (Goldman et al., 2018). To address these problems, green education has arisen as a possible strategy to improve the learning outcomes and experiences of learners at various levels of learning.

The other literature reviewed noted the contribution green education can make to the SDGs by attenuating energy consumption and energy operating costs. Light schemes which utilize lesser electricity as compare to other lights are often used in green schools. An improved energy use at such schools may be able to save about 20-40% of operating costs for the school which can be spent on other educational and institutional needs (Bajaj & Chiu, 2009).

These benefits are especially related to SDG 7, which is about access to affordable, reliable, sustainable and clean energy for all. To achieve this, green education can contribute by energy efficiency, international collaboration for enhancing access to energy technologies, and share in sustainable energy setup. Additionally, the reviewed studies show the function of GE to attain SDG 7, by implementing cleaner production practices to reduce carbon dioxide emissions (Bajaj & Chiu, 2009).

The perception of waste reduction has become more and more recognized as an important contribution towards environmental sustainability, since the World Summit on Sustainable Development in 2002. It includes the effective utilization of food-energy-water nexus and reduction of harmful by-products and pollution of air, water and soil. Cleaner production in manufacturing aims to minimize the negative health, safety and environmental effects of products throughout their life cycles, from extraction of raw materials to disposal at the end of the product's life cycle (Kopnina, 2012). It is the inclusion of the environment in the planning, designing and provision of services in the service sector. In general, cleaner production is a holistic and proactive method to solve environmental issues and ensure sustainability in various production and service processes (Fischer et al., 2022).

The literature reviewed also highlights the potential of cleaner production as a useful tool for enhancing environmental performance in the energy sector and contribute to the SDGs (Bajaj & Chiu, 2009). In the developing country context, like Pakistan, environmental protection must go hand in hand with economic growth and job creation. Cleaner production could be a win-win solution, as it can effectively decrease the environmental impacts and health risks without neglecting economic development.

Cleaner production strategies focus on environmental sustainability, operational efficiency and optimization of resource re-use, waste reduction and recycling at the organizational level. On the other hand, the authors emphasized that to ensure sustainable development, the integrated strategies should be developed, which focus on the environmental degradation and simultaneously ensure socio-economic prosperity at both national and international levels. Capacity building, the promotion of sustainable societal practices, and the development of appropriate visions, policies, methodological tools, and conceptual frameworks are all necessary for sustainable development as seen from this angle (Khalili et al., 2015).

Especially pertinent in the context of higher education because their proposed framework allows institutional leaders to evaluate the need for training programmes to build the human capital needed to support the SDGs (Khalili et al., 2015). This method is based on the expert judgment for assessing the significance of capacity development (CD) indicators and sustainable development indicators (Fischer et al., 2022). In line with these results, some of the studies analysed revealed that the incorporation of the subject of resource management in the school curriculum was one of the preferred solutions, and then the construction of specific programmes and initiatives related to sustainable economic development.

Cleaner production can also promote the life satisfaction, improve green efficiency, optimize the use of natural resources, and boost organizational competitiveness. In this regard, it can be used as a tool to advance the sustainability of the company, providing incentives for continuously improving environmental performance, optimizing the use of resources and reducing waste. In this aspect, cleaner production is a win-win approach that not only maintains consumer and employee health, safety, and environmental protection, but also improves the efficiency of production processes, productivity, competitiveness, and profitability. In this regard, cleaner production is a win-win approach which not only ensures consumer and employee health, safety and environmental protection, but also improves the efficiency of production processes, productivity, competitiveness, and profitability.

Given the proven link between renewable energy, the research reviewed recommend that clean manufacturing can play a key role in realizing SDG 12 and SDG 13. Cleaner production is a component of SDG 12, responsible consumption and production, which is part of the transition towards more sustainable patterns of consumption and production. Important SDG 12 targets are the adoption of environmentally friendly production methods and the reduction of waste generation. The literature reviewed indicates that the recycling rate in the world should be further raised by 2030 and organizations should be encouraged to implement sustainable practices in their operation and to publish sustainability reports. The cleaner production is also aligned with the international commitment 10-Year Framework of Programmes on Sustainable Consumption and Production, which aims to speed up the transition towards sustainable consumption and production systems.

Importance of cleaner production for the reduction of greenhouse gas (GHG) emissions and its contribution to SDG 13 which is related to Climate Action (Mogensen & Schnack, 2010). This objective highlights the importance of taking action ahead of climate change and its effects, such as controlling emissions and encouraging new developments in renewable energy and technology.

The promotional of water conservation, improvement of teacher retention, increased student attendance, distinctive learning opportunities and creating green employment opportunities also promote SDG 6 in green education. Green education is related to water sustainability as it helps ensure access to and sustainable use of water and sanitation for all. SDG 6 consists of eight targets which monitor progress towards SDG 6: ensuring access to water and sanitation for all, which many targets aim to be met by 2030. It highlights the importance of safe drinking water and sustainable water management, reflecting the principles of green education that promote responsible water utilization and conservation. Insufficient access to safely managed sanitation services and safe water services are ongoing challenges in the world, with the literature reporting that about 60% of the population do not have access to safely managed sanitation services, and 30% do not have access to safe water services (Adomßent et al., 2014).

These challenges can be mitigated by promoting water conservation, access to safe drinking water and the development of hygienic sanitation facilities through green education, which will lead to better and more productive communities. The studies reviewed indicate that there are benefits realized by reducing water consumption in green schools by about 32%, including direct financial savings and more comprehensive environmental benefits. These benefits include less overland flow, and less wastewater management and transport costs. Moreover, GE can provide a more stable employment situation for its teachers than normal schools, thus preventing more than 5% of teacher turnover, which leads to greater continuity in instruction, developing a stronger school community and realizing financial savings for educational institutions.

The literature reviewed also shows that student absenteeism in green schools is less than that in traditional schools. The other contribution of green education is that it can offer unique and practical educational opportunities. School buildings can serve as a very real learning tool, in which mathematics, environmental education and science could be combined in a meaningful way. Green building features, sustainable design, and advanced technologies can be used to help students learn how environmental friendly technologies are used in real-world applications.

In addition to the role played in SDGs 3, 6, 7, 12, and 13, green education can also contribute to SDG 8 by encouraging green employment and contributing to environmentally sustainable economic development. Investing in green education can help to build skills and human resources for emerging green industry, such as green architecture, sustainable construction and production of environmental-friendly building materials. The employment opportunities are closely related with SDG 8: Promote sustained, inclusive and sustainable economic growth, decent and productive jobs for all. Green education can also be a way to create jobs for youth by providing them with skills applicable to environmentally friendly jobs and assisting in general employment policies (Goldman et al., 2018).

The Green School in Bali is an example of how to apply green education. The institution was highly commended by Ban Ki-moon who called it a "particularly distinctive and impressive educational setting" (Goldman et al., 2018). Families, staff, faculty and members of the local community are brought together in a unified educational space, highlighting the school's importance. It is a culturally diverse community which gathers together a variety of languages, traditions, beliefs, identities, principles and values, which all contribute to tolerance, to widening perspectives and to increasing global awareness.

The school also affords opportunities for exploration, experiential learning, personal growth and community service. One of its aims is to build a sustainable learning space to share knowledge about innovative learning, global citizenship and being in relationship with others. The volunteer programme is intended to promote sharing and learning among its members and with others around the world (Goldman et al., 2018).

Volunteers, interns and staff obtain practical experience, occupational skills and enhance their communication and teamwork skills within multicultural environments. The school's working and learning environment is also focused on a whole school approach to campus life with regular check-ins and a focus on the need for balance in both academic and personal life. The role of volunteers and interns also contributes to the learning environment and building of opportunities for sharing community knowledge. These synergic experiences provide examples of how green education is able to promote innovative thinking and to help in exploring future educational possibilities, as demonstrated by the Green School in Bali.

In general, the literature reviewed showed the variety of green education contributions in terms of environment, education, social and economic aspects in sustainable development. Table-1 shows the major functions of green education and related connections to the SDGs.

Table 1: *The function and role of Green Education in attaining SDGs*

Green Education Role	Related SDGs
Encourages holistic thinking	SDG 3- Good Health and Well-being, (Miller et al., 2022)
Promotes quality education	SDG 4- Quality Education, (Saini et al., 2023)
Reduces energy costs	SDG 7- Affordable and Clean Energy, (Moallemi et al., 2020)
Reduces carbon emissions	SDG 13 (Climate Action)
Decreases water usage	SDG 6- Clean Water and Sanitation, (Ramírez Suárez et al., 2023)
Enhances teacher retention	SDG 8- Decent Work and Economic Growth, (Ramírez Suárez et al., 2023)
Reduces student absenteeism	SDG 4- Quality Education, (Saini et al., 2023)
Provides unique learning opportunities	SDG 4 (Quality Education, (Saini et al., 2023)
Creates green jobs	SDG 8- Decent Work and Economic Growth, (International Labour Organization. Research Department, 2023)

2.3 Strategies Utilized by Green Education (GE) in Nurturing SDGs

Overall, the reviewed studies show green education is an approach in promoting SDGs by integrating with nature-based learning. It has one of its goals to foster research excellence and innovation for the development of green growth, building research capacity, and solving ecological problems that enhance anthropoid welfare, can be characterized as alive way out which solve social problems in flexible, pliable and resource-effectual ways (Mogensen & Schnack, 2010).

For example, Clean Green Pakistan Movement was announced in 2018 in Pakistan to mobilize Institutions and citizens to improve the environment by Cleanliness, Sanitation, Safe Drinking Water, Waste Management and Tree Plantation. The goal was to make environmental protection a joint effort of government bodies and the public. In 2019, environmental concerns and tree planting initiatives through the Clean and Green Pakistan campaign came into the spotlight as part of a broader campaign to combat climate change and environmental sustainability.

Environmentally responsible action and public involvement in such initiatives are significant issues in green education. Examples of green behaviour at the educational level include plastic reduction, clean campus, appropriate disposal of waste and environmental awareness and conservation activities. Such practices show the potential of Environmental Education (EE) and advocacy in influencing people's behaviour towards sustainability and environmental protection.

The experiences of education efforts in the U.S. also show the power of the natural world in the support of sustainability. An experimental program was conducted in nine schools in North Carolina to study how nature-based learning impacts education. The assessment also took into account the pupils' contribution to the care of the environment, such as their participation in measures to improve the quality of the water and to enhance biodiversity. The study results showed that the use of nature-based learning was effective if it was accompanied by curriculum and policy approaches that included natural systems lessons (Miller et al., 2022).

Likewise, a scoping review, environmental education project was carried out at a communal institution in New York City. Students who participated in the programme have reported higher engagement, higher learning outcomes related to the programme and more concern for responsible environmental practices (Kras, 2022). These findings are in line with the overall research that indicates a positive effect of nature-based learning in boosting certain green learning outcomes, such as 'Environmental stewardship' (Jordan & Chawla, 2022).

The importance of training and networking as key strategies for building research capacity and advancing research excellence in the area of sustainability was also noted. These approaches focus on knowledge sharing, collaboration and capacity building to enhance the understanding of benefits of nature and the use of nature-based solutions (Müller-Christ et al., 2014).

The reviewed literature provides one example: The ReNature project in Malta which seeks to enhance the partnership between business, researchers and policy makers (Tomaškinová et al., 2021). The programme has helped to embed an evidence-based approach to environmental decision-making and planning. The importance of land-use planning is especially great in the context of expanding and building nature-based Solutions (Nbs) in towns, and to upkeep biota amenities and biological diversity.

The ReNature initiative has also contributed to consolidate the position of Malta in research and innovation, an emerging and relevant field for the SDGs. It is located within an island environment, which offers an opportunity to develop, test and evaluate policy and technical solutions in a specific environment. Stakeholder partnerships have strengthened capacities for research and helped inform and refine solutions that are practical and evidence-based.

Education and capacity building play a crucial role in green education as they provide the knowledge and skills to tackle matters of sustainability to individuals and organisations. Training on sustainability issues aids in focusing on relevant issues and linking learning activities with SDGs outcomes. Capacity building can also help organisations evaluate their current capacity and increase the capacity of the members to function effectively in complex, changing environments. For their sustainability and long-term success, it becomes crucial that such activities are evaluated systematically and carried out effectively. Based on the literature reviewed, training and capacity building are seen as important solutions to promote green education and sustainable development (Tundo & Griguol, 2018).

The literature reveals several other strategies by which education in green can facilitate the SDGs other than training, networking and capacity-building. These encompass stakeholder ownership/consultation, research and innovation, hallucination edifice and activism, linkages and conglomerates, and observing and valuation. In combination, these strategies offer a blueprint for embedding sustainability within the teaching and learning process, institutional decision making and other development programmes. Table 2 abridges the approaches applied by GE to nurture SDGs.

Table 2: *Strategies utilized by GE for nurturing SDGs*

Strategies	**Description**
Nature-Based Learning	Collaborating natural rudiments into education, nurturing a bridging with the environment, and boosting cognisant engagements for preservation (Ardoin et al., 2020).
Advancing Research Excellence	Accentuating research quality to discover eco or biotic system centred elucidations for economic progression, novelty, and ecological wellbeing (Liu et al., 2021).
Training and Capacity Development	Centring on communicating skills and knowledge line up to SDGs, evaluation of setup aptitude, and measuring associates' skills to work efficiently in multifaceted atmospheres (Moallemi et al., 2020).

Collaboration and Networking	Synergy with industries, legislators and shareholders to grow data grounded ecological heuristics and design, nurturing durable alliance, synergy and talent cultivation (Ulibarri, 2018).
Knowledge Integration and Capacity Development	Aim is creating awareness and competency development in subject linked to ecological elucidations, teaching organizations and individuals regarding nature aids, doles and training alignment with SDGs (Kioupi & Voulvoulis, 2019).
Vision Building and Advocacy	Development of vision for sustainability, promoting for ecologically liable policies, practices, and stimulating a communal hallucination for a more sustainable and greener future (Kioupi & Voulvoulis, 2019).
Networks and Strategic Partnerships	Cherishing linkages synergy and collaboration partnerships to improve practical research, consolidation of analytical mind, and provision of practically applied solutions grounded on systematic results and findings (El Hajj et al., 2020).
Monitoring and Evaluation	Applying observing and assessment to evaluate the effect of viability/sustainability creativities, warranting that progression line up to SDGs and activities guide to fruitful ending (Nabukalu et al., 2019).
Consultation and Community Engagement	Partnership with societies, shareholders and public, pursuing contribution/effort and make sure that eco-friendly creativities are pertinent and operational, nurturing a nous of possession and promise to eco-friendly initiatives (Zikargae et al., 2022).
Research and Innovation	Encouragement of research and innovation for the improvement and implementation of long-term or lasting solutions, centring to find novel and inventive methods for addressing ecological barriers and the promotion of SDGs (Moallemi et al., 2020).
Planning for Land Usage and Green Infrastructure	Accentuating to plan usage of land and advancement in Green Infrastructure in built-up zones, Backing up ecology amenities, bio-diversity, and application of environment built way out for SDGs (Du Toit et al., 2018).

2.4 Outcomes and Impact of Green Education

Results from synthesis of designated studies showed that upshots and effect of GE since 20 years have improved significantly, since the perception has begun to be recognized. In a study of ESD programmes in 18 countries between 2005 and 2014 were mainly the establishment of evidence of perception. During the initial stage, much of the focus of green education was on achieving environmental awareness, involving stakeholders, and finding ways to start integrating sustainability education slowly into formal and informal learning spaces (Laurie et al., 2016).

If feasible and awareness raising were the priorities of green education before 2014, after 2014, it was to be more focused on building capacity, experimentation and implementation of effective practices. Focus shifted towards changing educational paradigms, including the incorporation of GE in the formal as well informal syllabi, and measuring the real effect of green education on stableness / Stability (Laurie et al., 2016).

Remarkably, the majority of the selected research works published after 2014 were those which focused on outcomes and impacts of green education. This is a change that awareness raising and feasibility studies toward assessing its real-world impact on sustainable development. The opportunity of green education for the transformation of societies towards sustainability was underlined in one study (Kioupi

& Voulvoulis, 2019). The view here is that green education can help to promote the SDGs in three different phases for educational stakeholders. The first step is to establish a consensus on the vision of sustainability. The second is about the skills that people require to attain that vision. During the third phase, classroom teachers and other education stakeholders develop suitable teaching strategies to enable the realization of the above competencies (Kioupi & Voulvoulis, 2019).

The use of green education to inspire a transformation of society has yielded positive results in many aspects of sustainable life. First, the implementation of green education can promote the consumption that is conducive to the environment. Green education as a possible factor to achieve carbon neutrality, stating that environmental education can enhance people's understanding of environmental problems and their environmental protection responsibilities (Wu et al., 2023). As environmental awareness grows, people may decrease their environmental burden, change their consumption habits and force manufacturers to engage in cleaner production.

Second, GE is the core of increasing the awareness and understanding of renewable energy technologies. It doesn't only spread the word; it can also help foster a more mindful shift to cleaner fuels. GE would perform its part in the broader goals of sustainability by encouraging the use of renewable energy and decreasing carbon emissions as well as stimulating economic growth (Zafar et al., 2020).

Last, but not least, green education enables the creation of ‘green communities' with a greater readiness and willingness to act for the environment. It can facilitate the translation of sustainability research into practical initiatives, and enhance the integration of scientific knowledge and action to address climate change. Education provides knowledge and values and attitudes for environmental protection and sustainability. These qualities, in turn, help to build skills that enable individuals and communities to have an impact on the environment in a meaningful way (Ardoin et al., 2020).

In general, the green education development from raising awareness, showing the possibility and inducing sustainable behaviours indicates that the green education has become more and more important in society. There is a growing body of research increasingly focusing on its role in the responsible consumption, environmental protection, clean energy transition, cleaner production and other aspects of sustainability. The advances mentioned indicate that the potential of applying green education to help meet SDGs, on an individual and social level.

2.5 Barriers and Challenges Recognised in Applying GE (green education) for Sustainable/ecological Improvement, and by what means various Studies Addressed Them

Pessimistic influence of approximate elements of GE, such as EE, on the general EE optimisms is one of the greatest hindrances in implementing the green education for sustainable development. While the benefits of green education are numerous, it can also communicate a negative message about the environment and global ecosystem (Edsand & Broich, 2020). Moreover, adjusting for learners' Triple Bottom Line, Edsand & Broich, (2020), instituted that factors of GE mostly promoted concerns on the environment and motivated proper environmental behaviour from socio-economically higher learners. These difficulties could restrict the function of GE in supporting SDG 4,10 and 13. The study therefore, proposed expanding the focus of instruction from structured and unstructured learning environments in that the learning experiences and interactions in both contexts contribute to inculcating environmental awareness.

One of the major problems is the lack of integration into teacher training programmes and teacher education of ESD though almost 10 years after the concept was introduced to raise awareness. A research explored the barricades to the implementation of GE in the State of Qatar reported that teacher training is an important element in the implementation of SDGs, especially SDG 4, but there are several challenges and important elements for implementing green education in SDGs and teacher education curricula as illustrated in (Figure-1). Teachers also mentioned that they had less access to resources and teaching

materials, sustainability themes were not covered adequately across the curriculum, and there was a dearth of a characterisation of ecology that is common across the country (Hamwy et al., 2023).

The low level of incorporation of GE in structured teaching courses is not only found in Qatar, but has also been seen in other countries. GE and its function in sustainability, for instance, are well known in Israel (Goldman et al., 2018). Nevertheless, for green education to have a greater impact on sustainability, the lack of a systematic development of curriculum and integration of green education is still a major challenge (Miedijensky & Abramovich, 2019). Likewise, in a study on barriers to green education for Korean teachers, three major barriers were found: green education is not well adapted to the current curriculum, teachers' lack of knowledge regarding green education, and insufficient green education teaching materials (Kang, 2019).

Hamwy et al. (2023), suggested, to address these challenges, that more institutional support needs to be given to teachers, that ESD issues need to be incorporated into systematic curriculum and that educators need ample understanding, training and capitals regarding sustainability. Similar strategies have been suggested in a research on application of ESD in Norway that focused on embedding ESD in the school curriculum and leveraging the use of a variety of media to raise awareness about sustainability issues (Kang, 2019). Overall, the reviewed studies show that integration of the green education in the curriculum is not enough to implement its effectiveness; trained teachers, suitable teaching materials, institutional support, and learning opportunities that are not limited to formal educational institutions, but also informal learning institutions, are needed to achieve the effectiveness of green education.

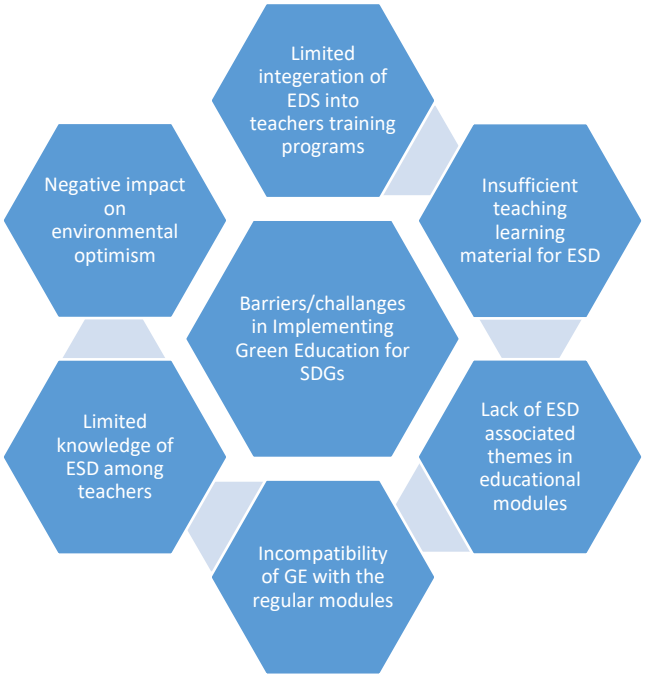


Figure-1: *Barriers in applying GE for SDGs.*

3 METHODOLOGY

3.1 Design and Selection of the Study

Narrative/traditional literature review was an ideal as a main review stratagem and approach for present research study. The methodology was constructive for instituting and founding whether GE is valuable for achievement of SDGs because of its dependency on an abstract of number of foundations of

indication. The literature review was carried out using the time frame 2000-2025 to analyse the role of Green Education and its contribution to achieving SDGs. Relevant research papers were chosen based on the theme and objectives of study. Educational databases such as Scopus, Web of Science, and Education Resources Information Center (ERIC) were searched in addition to search engines like Google, Google Scholar, and Semantic Scholar. The literature search was based on certain keywords and phrases such as "Green Education", "Sustainable Development Goals", and "Sustainability" to identify studies that had sustainability themes. Boolean search operators or strings, specifically AND and OR, were used to narrow and focus the search to find relevant studies. For example, the combination of Green Education OR Environmental Education and Green Education AND SDGs were employed to find the articles closely related to the theme of the study. Data retrieved were then extracted, sorted and coded based on the geographical location and type of study.

Utmost vitally, review had adopted as a method for the study used as it curtails the predisposition of the process of arriving at conclusions (Mallett et al., 2012). The traditional literature review method was used mainly to analyse the philosophies and opinions on GE and SDGs, and their effects for sustainability. This study sought to explore and pinpoint the different aspects of green education's contribution to SDGs, by compiling and integrating previously published literature on the subject. This study aimed to identify and highlight the aspects of green education that contribute to the achievement of the SDGs by compiling and integrating the literature already published on the topic.

3.2 Inclusion and Exclusion Criteria (Selection and Screening)

Inclusion/exclusion criteria were developed to select relevant literature that focuses on the function of GE and its contribution toward the SDGs. Literature was done and articles written in English were included and published between 2000 and 2025. To some extent, eligibility/ suitability screening was used at two phases of evaluation so that to enforce different screens with further thoroughness. Foresaid screens which were used were an abstracts reading first and main titles to eradicate studies that are not related and valuation of the studies' complete manuscript version. Conservatism was applied during every step to make sure that only those articles are excluded who failed to fulfil the inclusion criteria. If there were any doubts regarding some of the articles, for more scrutiny and analysis they were taken to the next stage. In case the aptness and suitability after screening of a complete transcript remains blurred, additional info were pursued after when possible to permit the research to be assimilated or omitted.

The relevant studies were found by using Google search, ERIC, Scopus, Web of Science (WoS), and Semantic Scholar. Studies were included if they focused on the field of green education, environmental education, education for sustainable development or other approaches to environmental education and its relation to sustainable development awareness, environmental responsibility, sustainable practices, and/or the SDG implementation. Non-peer reviewed publications, studies not related to research questions, publications with topics other than the research questions, ineligible publication types, and work in progress were excluded.

The selection of studies was conducted through the following steps: the study was included in the screening according to the 2020 PRISMA flow diagram illustrated in Figure-2. 350 records were found in the selected sources of search. The records were screened for title and abstract, with 50 records removed before screening. The number of 180 records were further removed based on the topics that were not related to the research subject and on the predefined eligibility criteria. The other 120 reports were attempted for full text retrieval, but could not be retrieved 10 reports. Therefore, 110 full text reports were evaluated for eligibility. Of those reports, 50 reports were excluded after full text review, due to no relevance to the research questions, not peer-reviewed, not published in eligible journals and/or not completed due to study requirements. Finally, 60 studies were selected and included in the final review. The selection process and why someone was not selected were recorded to ensure transparency and consistency in the review. All carefully chosen studies were amalgamated and analysed to produce a synthesis of conclusions.

Table 3: *Inclusion and exclusion criteria*

Research Studies Were Included if They:	Research Studies Were Excluded if They:
Focused on the application, integration, or impact green education on SDGs;	Did not explicitly discourse green education and SDGs;
Were secondary sources (e.g., reviews, opinion papers, meta-analyses);	Empirical research studies which were experimental, quasi-experimental, or other data-driven research methods;
Were published in peer-reviewed journals;	Were the work-in-progress;
Provided data related to the research questions.	Lacking methodological facet (e.g., mislaid or vague design, sample, data collection, or analysis).

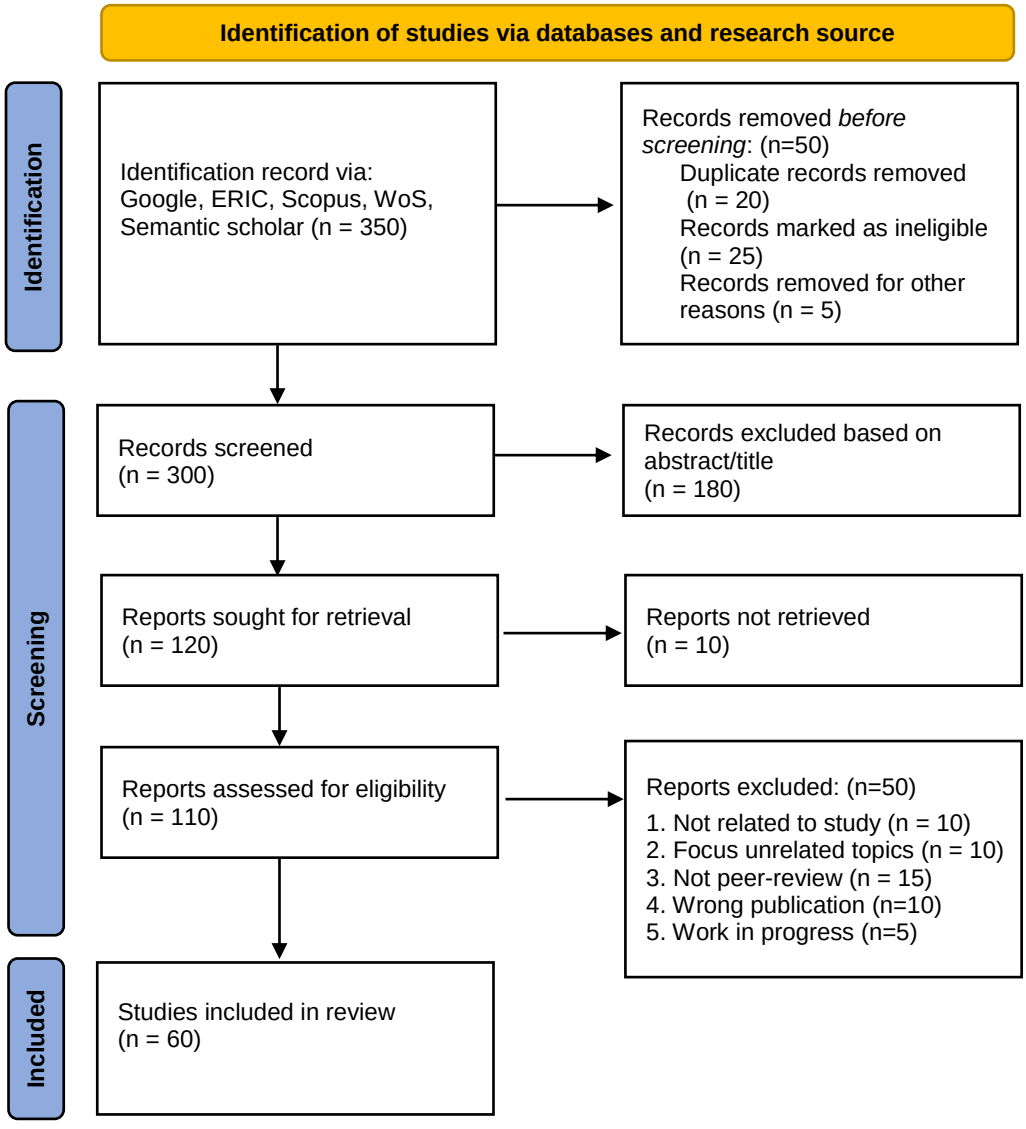


Figure-2. *PRISMA flow chart/diagram elucidating the selection procedure of the studies*

To ensure the reliability and consistency of the data extraction and coding process, the researchers independently coded a subset of 20 studies from the 60 studies included in the literature review. The coding focused on key aspects relevant to the research objectives, including the role of green education, its contribution to the SDGs, sustainability-related themes, geographical context, study type, and the strategies or educational approaches used to promote sustainable development. Any discrepancies identified during the coding process were discussed and resolved through mutual consensus. Following this process, the finalized coding framework was applied consistently to all studies included in the review.

A conceptual network diagram was created based on the 60 studies presented in the review to show the principal relationships identified from the literature. The results show that the key support points of GE are green curriculum, green teaching and learning, environmental awareness activities and green institutional practices. These areas are related with sustainable knowledge, environmental attitudes, sustainability competencies and sustainable behaviour. Overall, these outcomes illustrate the potential impact of GE on the six targeted Sustainable Development Goals (SDGs): SDG 3, SDG 4, SDG 7, SDG 8, SDG 12 and SDG 13 as illustrated in Figure-3.

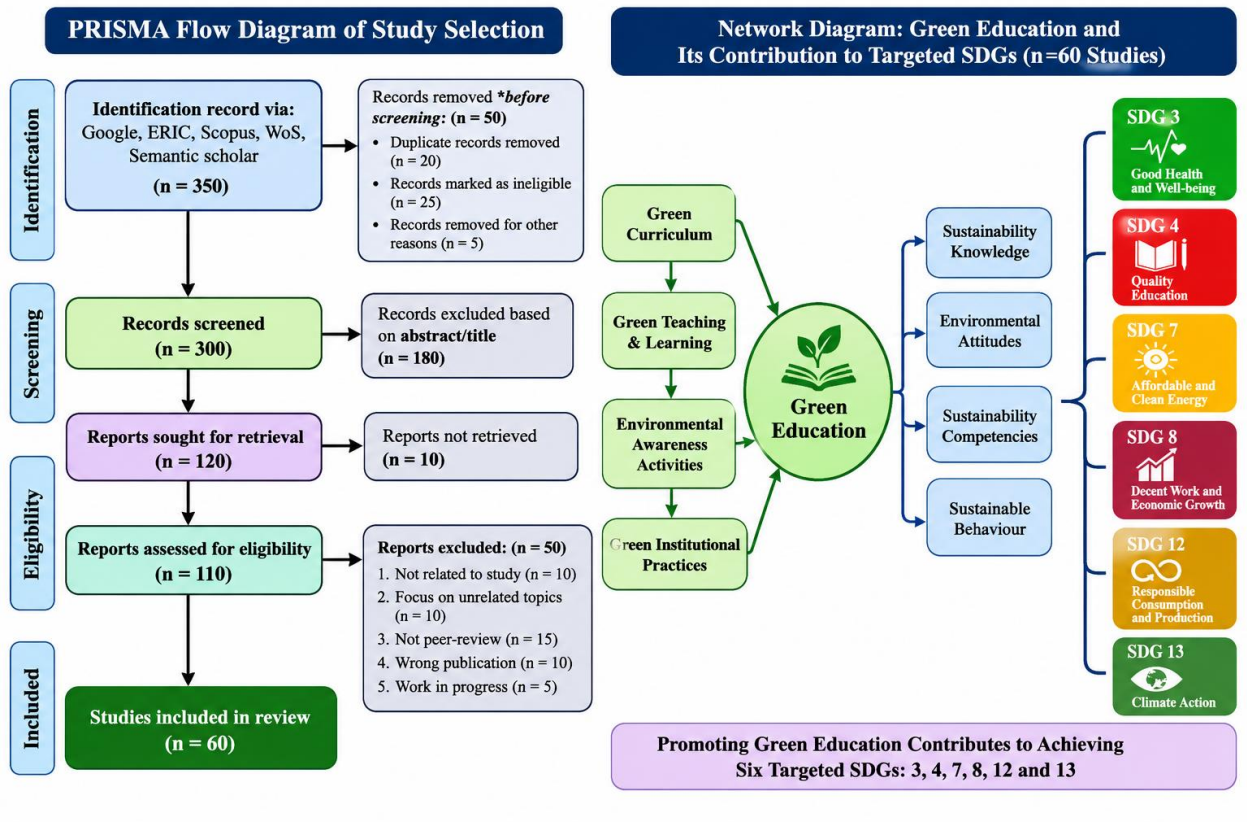


Figure-3. *A conceptual network diagram.*

4. RESULTS/FINDINGS OF THE LITERATURE REVIEW

The synthesis of the selected studies revealed that green education is widely conceptualized as an educational approach aimed at developing the knowledge, skills, and values necessary to build a sustainable future (Mallett et al., 2012). It provides educators with practical learning frameworks that connect scientific knowledge, technology, and social systems with real-world contexts. Furthermore, green education equips individuals with the knowledge, competencies, values, and attitudes required to contribute to a sustainable future (Venkataraman, 2009). GE involves incorporating key sustainable

development problems in teaching-learning, comprising of calamity danger lessening, sustainable depletion, climate change, dearth alleviation, and bio-diversity conservation. The studied literature also highlights the importance of participatory teaching and learning approaches that empower and motivate learners to adopt sustainable behaviours and take meaningful action (Ibezim, 2013). Through these approaches, green education promotes essential capabilities such as critical and creative rational, synergy in decision-making, and responsible action. Its implementation, therefore, requires substantial changes in conventional educational practices. The reviewed studies further indicate that GE performs a significant function in promoting a sustainable society and is relevant across all levels of formal education and training, as well as informal and non-formal learning environments (Juntunen & Aksela, 2014). Its scope extends beyond addressing present needs to include the protection and enhancement of quality of life for both current and future generations (Vare & Scott, 2007). In the context of SDGs, GE can thus be understood as a process through which individuals acquire the knowledge, skills, values, and experiences necessary to participate in individual and collective decision-making at local and global levels, thereby improving present living conditions without compromising the planet's ability to sustain future generations (Ekwueme et al., 2016). The reviewed studies also suggest that no single pedagogical approach is universally suitable for green education. Instead, the literature emphasizes the need to move towards active, participatory, and experiential learning methods that engage learners and enhance their understanding, critical thinking, and capacity for action. Five key pedagogical elements were identified as particularly relevant to incorporating GE into erudition environments: critical reflection, systems thinking and analysis, participatory learning, creative thinking, and collaborative learning (Vare & Scott, 2007). Critical reflection can be facilitated through conventional lectures as well as learner-centered activities, such as reflective periodicals, argumentative groups, and reflexive accounts (Machost & Stains, 2023). Systems thinking and analysis involve the use of actual case studies, crisis situations, incentive based doings, campus initiatives, and experiential education to help learners understand the interconnected nature of sustainability challenges (Huckle & Wals, 2015). Collaborative learning stresses pupils interaction, cluster activities, experience-based education, action research, and discourse. It may also involve collaborative decision-making and the development of case studies in partnership with businesses and community organizations. Creative thinking can be encouraged through role-playing, problem-based learning, open-ended learning activities, and future-oriented visioning exercises. Collaborative learning, in turn, involves co-inquiry, teamwork, work-based learning, and contributions from guest speakers to facilitate shared knowledge construction and collective learning. Collectively, these pedagogical approaches support the integration of green education principles into educational settings and encourage learners to engage actively with sustainability-related challenges.

Result/Finding of literature review related to RQ-1. What are the vital conceptual aspects of green education acknowledged in the current literature?

The review showed that the education of green learning provides teachers and students with the proper educational resources and curricula that emphasize a comprehensive and critical understanding of global environmental issues and how to address them (Bajaj & Chiu, 2009). In addition to all that, there are many advantages that teachers, students, parents and the community can enjoy by attending green schools. This encompasses positive health outcomes, better academic achievement, reduced operating costs, reduced carbon emissions, water savings, and unique learning experiences. Green education contributes to SDG 3. Ensure healthy lives and promote well-being for all by fostering healthier living and learning environments, which benefits teachers, students and communities. GE will benefit SDG 4 by enhancing student learning outcomes and quality education, in addition to supporting SDG 3. The reviewed studies show that students' test scores can improve significantly if they are educated in green classrooms that feature better daylighting, acoustic conditions and cleaner carpets and paints, which release fewer toxic substances indoors (Jickling & Wals, 2008). The other literature reviewed noted the contribution green education can make to the SDGs by lowering energy consumption and energy operating costs. An improved energy use at such schools may be able to save about 20-40% of operating costs for the school which can be spent on other educational and institutional needs. These benefits are

especially related to SDG 7, which is about access to affordable, reliable, sustainable and clean energy for all. Additionally, the reviewed studies show the function of GE in attaining SDG 7, by implementing cleaner production practices to reduce carbon dioxide emissions. The literature reviewed also highlights the potential of cleaner production as a useful tool for enhancing environmental performance in the energy sector and contribute to the SDGs (Bajaj & Chiu, 2009). Given the proven link between green energy and pollution prevention, the studies reviewed suggest that cleaner production can play a key role in realizing SDG 12 and SDG 13. The importance of cleaner production for the reduction of GHG emissions and its contribution to SDG 13 which is related to Climate Action (Mogensen & Schnack, 2010). The promotion of water conservation, improvement of teacher retention, increased student attendance, distinctive learning opportunities and creating green employment opportunities also promote SDG 6 in green education. Green education is related to water sustainability as it helps ensure access to and sustainable use of water and sanitation for all. The studies reviewed indicate that there are benefits realized by reducing water consumption in green schools by about 32%, including direct financial savings and more comprehensive environmental benefits. The literature reviewed also shows that student absenteeism in green schools is less than that in traditional schools. In addition to the role played in SDGs 3, 6, 7, 12, and 13, green education can also contribute to SDG 8 by encouraging green employment and contributing to environmentally sustainable economic development. Investing in green education can help to build skills and human resources for emerging green industry, such as green architecture, sustainable construction and production of environmental-friendly building materials (Goldman et al., 2018). In general, the literature reviewed showed the variety of green education contributions in terms of environment, education, social and economic aspects in sustainable development.

Result/Finding of literature review related to RQ-2. Via what procedure does green education accelerate to the attainment of the Sustainable Development Goals?

Overall, the reviewed studies show GE is an approach in promoting SDGs by integrating with nature-based learning. It has one of its goals to foster research excellence and innovation for the development of biophilic elucidations for economic progression, building research capacity and solving green problems that enhance anthropological welfare, can be characterized as incarnate elucidations that solve social problems in flexible, flexible and resource effectual ways (Mogensen & Schnack, 2010). Environmentally responsible action and public involvement in such initiatives are significant issues in green education. Examples of green behaviour at the educational level include plastic reduction, clean campus, appropriate disposal of waste and environmental awareness and conservation activities. The study results showed that the use of nature-based learning was effective if it was accompanied by curriculum and policy approaches that included natural systems lessons (Miller et al., 2022). The students who participated in the programme have reported higher engagement, higher learning outcomes related to the programme and more concern for responsible environmental practices (Kras, 2022). These findings are in line with the overall research that indicates a positive effect of nature-based learning in boosting certain green learning outcomes, such as ‘Environmental stewardship'. The importance of training and networking as key strategies for building research capacity and advancing research excellence in the area of sustainability was also noted. The reviewed literature provides one example: The ReNature project in Malta which seeks to enhance the partnership between business, researchers and policy makers. Education and capacity building play a crucial role in green education as they provide the knowledge and skills to tackle matters of sustainability to individuals and organisations. Based on the literature reviewed, training and capacity building are seen as important solutions to promote green education and sustainable development (Tundo & Griguol, 2018). The literature reveals several other strategies by which education in green can facilitate the SDGs other than training, networking and capacity-building. These encompass stakeholder ownership/consultation, continuous improvement, strategic planning and encouragement, joint ventures, and review and assessment.

Result/Finding of literature review related to RQ-3. What key barriers and prospects impact the consolidation of green education into educational strategies for sustainable development?

The results from integration of the particular studies showed that results and effect of GE have significantly improved in past two decades, since the conception has begun to be recognized. During the initial stage, much of the emphasis of GE was on achieving environmental awareness, involving stakeholders, and finding ways to start integrating sustainability education slowly into formal and informal learning spaces. Awareness raising were the priorities of GE before 2014, after 2014, it was to be more focused on building capacity, experimentation and implementation of effective practices. Focus shifted towards changing educational paradigms, including the incorporation of GE in the overt and tacit courses and measuring the real influence of GE on sustainability (Laurie et al., 2016).. Remarkably, the majority of the selected research works published since 2014 were those which focused on outcomes and impacts of GE. Opportunity of GE for the makeover of cultures in the direction of sustainability was underlined in one study (Kioupi & Voulvoulis, 2019). GE could perform its part in the broader goals for sustainability by encouraging the use of renewable energy and decreasing carbon emissions as well as stimulating economic growth (Zafar et al., 2020). It can facilitate the translation of sustainability research into practical initiatives, and enhance the integration of scientific knowledge and action to address climate change. Education provides knowledge and values and attitudes for environmental protection and sustainability. These qualities, in turn, help to build skills that enable individuals and communities to have an impact on the environment in a meaningful way (Ardoin et al., 2020). In general, the green education development from raising awareness, showing the possibility and inducing sustainable behaviour indicates that the green education has become more and more important in society. There is a growing body of research increasingly focusing on its role in the responsible consumption, environmental protection, clean energy transition, cleaner production and other aspects of sustainability.

Deleterious influence of some elements of GE, such as EE, on the general EE optimisms is one of the greatest hindrances in executing the GE for sustainable growth. These difficulties could restrict the function of GE in supporting SDGs 4, 10 and 13. Teachers also mentioned that they had less access to resources and teaching materials, sustainability themes were not covered adequately across the curriculum, and there was a lack of a definition of sustainability that is common across the country (Edsand & Broich, 2020). Nevertheless, for green education to have a greater impact on sustainability, the lack of a systematic development of curriculum and integration of green education is still a major challenge (Miedijensky & Abramovich, 2019). Likewise, in a study on barriers to green education for Korean teachers, three major barriers were found: green education is not well adapted to the current curriculum, teachers' lack of knowledge regarding green education, and insufficient green education teaching materials (Kang, 2019). Overall, the reviewed studies show that integration of the green education in the curriculum is not enough to implement its effectiveness; trained teachers, suitable teaching materials, institutional support, and learning opportunities that are not limited to formal educational institutions, but also informal learning institutions, are needed to achieve the effectiveness of green education.

Conceptual Network Diagram *of Green Education, Pedagogical Approaches, and Targeted SDGs*

The network diagram is a synthesis of the results of the reviewed studies, presenting the conceptual relationships between the concepts of green education, these concepts and pedagogical strategies, on the one hand, and the concepts and SDGs that are linked to green education, on the other. The synthesis reveals that green education functions via knowledge and skills, values and attitudes, participatory learning, sustainability-related issues, and key pedagogical approaches that all together influence sustainable learning and behaviour, and are responsive to the targeted SDGs. Details are illustrated in the conceptual network diagram Fog-4.

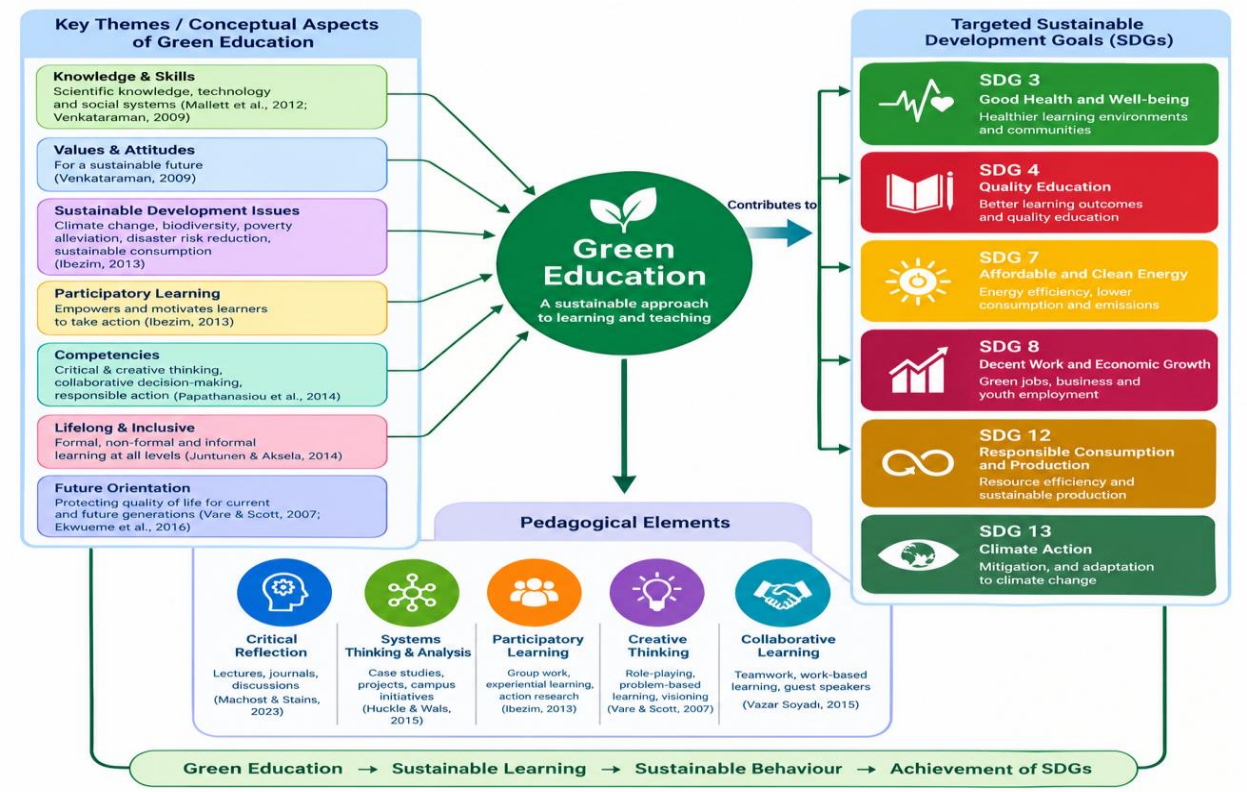


Figure-4. *Conceptual Network Diagram of Green Education, Pedagogical Approaches, and Targeted SDGs.*

5. CONCLUSION

Green education is an important way to help realize the Sustainable Development Goals (SDGs) and has a great potential to create even more benefits if it is well implemented in the education systems. The studies reviewed demonstrate its critical importance in embedding sustainability concepts into teaching-learning with participatory approaches which involve and encourage students to take up pro-ecological actions.

Green education helps to achieve SDG 3 in terms of the health and well-being of educational stakeholders, and SDG 4 with respect to better learning outcomes and quality education. It also promotes SDG 7 by fostering energy efficiency and lower energy consumption/emissions by using sustainable materials and systems in green schools. Furthermore, GE adds to SDG 8 through the creation of green jobs and green business, inclusive economic growth and increased employment opportunities for the youth.

Likewise, cleaner production is part of a green education, which plays a role in SDGs 12 and 13 as it increases the efficiency of the use of resources, promotes responsible production and consumption, and reduces risks to the environment. The teaching of green education also has the advantages of conserving water, increasing instructor retaining rate as well as student presence rate, provides distinctive learning prospects. Together, these aids contribute to the several SDGs, including water stewardship, top-notch education, environmental sustainability and trade and industry development.

Venue of GE is so complex that targeted training, research, capacity building and advocacy are necessary so that green education can work well and give maximum benefit. In conclusion, the results highlight the prospective of GE to add significantly to SDGs and creation of a more sustainable and desirable future for current and future generations, given its comprehensive and innovative perspective.

5.1 Recommendations

The results and recommendations presented in the reviewed studies reveal multiple ways in which the process of green education could be applied to help realise the SDGs.

Education is strongly interlinked with the objectives of the SDGs for sustainability (Cai & Wolff, 2022). The use of the GE approach in formal education systems can build up a population who is more aware of the concept of sustainability and can contribute to achieving the SDGs by introducing innovations in clean energy, utilizing water and natural resource resources more efficiently and minimizing the loss of waste, and encouraging green entrepreneurship. Green education has the potential to make a considerable contribution to shifting the attitude and behaviour of society toward sustainability in this aspect. It can thus contribute to a paradigm shift in the personal and communal understanding and practice of sustainable living. In order to achieve these changes in attitudes and behaviours in society, green education may take a behavioural approach, much like the approach taken in environmental conservation programmes, such as those linked to the Kyoto Protocol.

Moreover, GE is truly multifaceted and has socio-ecological-economic systems (SEES) aspects of sustainability, providing students with understanding and skills to create and participate in sustainable societies (Parry & Metzger, 2023). By incorporating sustainability-related concepts in other academic fields, it is therefore possible to foster the creation of viable and ecological cultures by making pupils active proxies of the communal and environmental transformation.

5.2 Further Research

Number of researches have examined the relationship among education, EE, and SDGs as William Snapp introduced the conception of EE (Fang et al., 2023). However, green education is a relatively emerging concept, and research examining its interaction with other fields, particularly sustainability, remains limited. Therefore, further research is needed to explore the intersection of GE to other subjects, areas and fields with particular emphasis on its potential functioning to support the attainment of SDGs. Such studies could provide a deeper understanding of how green education can be integrated across different contexts and contribute to broader sustainability objectives.

5.3 Conceptual Model for Future Researchers

The results of this literature review suggest a conceptual model that can be used by future researchers in the study of how Green Education contributes to the Sustainable Development Goals (SDGs). While the relationship between education and EE and the SDGs has been explored in many studies (Fang et al., 2023), the link between EE and sustainability and other disciplines and sectors are still not fully explored (Green Education) as it is a new concept. The proposed model is based on conception of GE and posits that its incorporation in curricula, teaching-learning activities, environmental awareness creation activities, and institutional practices could foster sustainability knowledge, environmental attitudes, sustainability competencies and sustainability behaviour. These learning outcomes can help advance the six SDG's that are addressed in this review: SDG 3 (Good Health and Well-Being), SDG 4 (Quality Education), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). The model offers a basis for future researchers to explore these proposed relationships quantitatively, qualitatively, or in a mixed method within a variety of learning contexts, geographic locations, and discipline. The contextual factors that affect the effectiveness of Green Education and the role of this approach in achieving particular targets of SDGs can also be explored in future studies. The proposed model is then tested and refined empirically in future studies, which will lend the model a deeper meaning and further support the achievement of broader sustainability goals by integrating Green Education into various contexts. The conceptual model for future researchers study is illustrated in Figure-5.

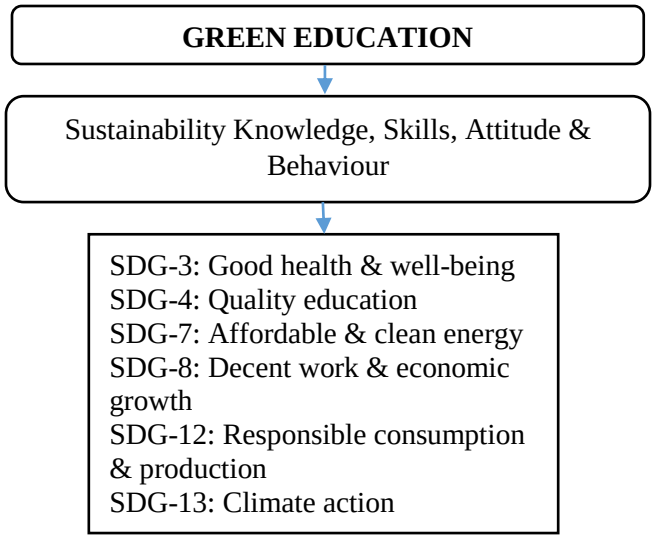


Figure-5. *Conceptual model for future researchers study*.

Acknowledgments

The authors acknowledge the use of AI ChatGPT for the generation of Figure 3 & 4 and used Grammarly for grammatical improvement. All content refined using this tool was critically evaluated and appropriately reviewed by the authors. The authors take full responsibility for the accuracy, integrity, and originality of the content presented in this article.

Authors Contribution

Dr. Muhammad Yousaf and Dr. Ahmed Ali Qureshi contributed to the study design and data collection, Dr. Abdul Khaliq Shaheen and Dr. Muhammad Shuaib drafted the manuscript and revised, proofread the research work. All authors read and approved the final manuscript.

Disclosure Statement

No potential conflict of interest was reported by the authors.

Funding Source

The authors received NO funding to conduct this study.

Data Availability Statement

The data supporting the findings of this review are derived from previously published studies and are available in the cited articles and their supplementary materials. No original datasets were generated during the preparation of this review.

Ethical Approval

Not Applicable.

ORCID IDs

Muhammad Yousaf [1] https://orcid.org/0009-0004-6271-708X
Ahmed Ali Qureshi [2] https://orcid.org/0009-0005-1511-1277
Abdul Khaliq Shaheen [3] https://orcid.org/0000-0002-6869-848X
Muhammad Shuaib [4] https://orcid.org/0009-0004-1120-6423

REFERENCES

Adomßent, M., Fischer, D., Godemann, J., Herzig, C., Otte, I., Rieckmann, M., & Timm, J. (2014). Emerging areas in research on higher education for sustainable development – management education, sustainable consumption and perspectives from Central and Eastern Europe. *Journal of Cleaner Production*, *62*, 1–7. https://doi.org/10.1016/j.jclepro.2013.09.045

Akinsemolu, A. A., & Onyeaka, H. (2025). The role of green education in achieving the sustainable development goals: A review. *Renewable and Sustainable Energy Reviews*, *210*, 115239. https://doi.org/10.1016/j.rser.2024.115239

Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. *Biological Conservation*, *241*, 108224. https://doi.org/10.1016/j.biocon.2019.108224

Bajaj, M., & Chiu, B. (2009). Education for Sustainable Development as Peace Education. *Peace & Change*, *34*(4), 441–455. https://doi.org/10.1111/j.1468-0130.2009.00593.x

Cai, Y., & Wolff, L.-A. (2022). Education and Sustainable Development Goals. *Sustainability*, *15*(1), 643. https://doi.org/10.3390/su15010643

Du Toit, M. J., Cilliers, S. S., Dallimer, M., Goddard, M., Guenat, S., & Cornelius, S. F. (2018). Urban green infrastructure and ecosystem services in sub-Saharan Africa. *Landscape and Urban Planning*, *180*, 249–261. https://doi.org/10.1016/j.landurbplan.2018.06.001

Edsand, H.-E., & Broich, T. (2020). The Impact of Environmental Education on Environmental and Renewable Energy Technology Awareness: Empirical Evidence from Colombia. *International Journal of Science and Mathematics Education*, *18*(4), 611–634. https://doi.org/10.1007/s10763-019-09988-x

Ekwueme, C. O., Ekon, E. E., & Ezenwa-Nebife, D. C. (2016). Education for sustainability through academic freedom. *Global Journal of Educational Research*, *15*(1), 23. https://doi.org/10.4314/gjedr.v15i1.3

El Hajj, T., Gregorius, S., Pulford, J., & Bates, I. (2020). Strengthening capacity for natural sciences research: A qualitative assessment to identify good practices, capacity gaps and investment priorities in African research institutions. *PLOS ONE*, *15*(1), e0228261. https://doi.org/10.1371/journal.pone.0228261

Fang, W.-T., Hassan, A., & LePage, B. A. (2023). Introduction to Environmental Education. In W.-T. Fang, A. Hassan, & B. A. LePage, *The Living Environmental Education* (pp. 3–24). Springer Nature Singapore. https://doi.org/10.1007/978-981-19-4234-1_1

Fischer, D., King, J., Rieckmann, M., Barth, M., Büssing, A., Hemmer, I., & Lindau-Bank, D. (2022). Teacher Education for Sustainable Development: A Review of an Emerging Research Field. *Journal of Teacher Education*, *73*(5), 509–524. https://doi.org/10.1177/00224871221105784

Goldman, D., Ayalon, O., Baum, D., & Weiss, B. (2018). Influence of 'green school certification' on students' environmental literacy and adoption of sustainable practice by schools. *Journal of Cleaner Production*, *183*, 1300–1313. https://doi.org/10.1016/j.jclepro.2018.02.176

Grosseck, G., Țîru, L. G., & Bran, R. A. (2019). Education for Sustainable Development: Evolution and Perspectives: A Bibliometric Review of Research, 1992–2018. *Sustainability*, *11*(21), 6136. https://doi.org/10.3390/su11216136

Hamwy, N., Bruder, J., Sellami, A., & Romanowski, M. H. (2023). Challenges to Teachers Implementing Sustainable Development Goals Frameworks in Qatar. *Sustainability*, *15*(15), 11479. https://doi.org/10.3390/su151511479

Huckle, J., & Wals, A. E. J. (2015). The UN Decade of Education for Sustainable Development: Business as usual in the end. *Environmental Education Research*, *21*(3), 491–505. https://doi.org/10.1080/13504622.2015.1011084

Ibezim, N. E. (2013). Technologies Needed for Sustainable E-Learning in University Education. *Modern Economy*, *04*(10), 633–638. https://doi.org/10.4236/me.2013.410068

International Labour Organization. Research Department,. (2023). *Transformative change and SDG 8: The critical role of collective capabilities and societal learning*. ILO. https://doi.org/10.54394/HKDP3268

Jickling, B., & Wals, A. E. J. (2008). Globalization and environmental education: Looking beyond sustainable development. *Journal of Curriculum Studies*, *40*(1), 1–21. https://doi.org/10.1080/00220270701684667

Jordan, C., & Chawla, L. (2022). A Coordinated Research Agenda for Nature-Based Learning. In R. Jucker & J. Von Au (Eds.), *High-Quality Outdoor Learning* (pp. 29–46). Springer International Publishing. https://doi.org/10.1007/978-3-031-04108-2_2

Juntunen, M. K., & Aksela, M. K. (2014). Education for sustainable development in chemistry – challenges, possibilities and pedagogical models in Finland and elsewhere. *Chem. Educ. Res. Pract.*, *15*(4), 488–500. https://doi.org/10.1039/C4RP00128A

Kang, W. (2019). Perceived Barriers to Implementing Education for Sustainable Development among Korean Teachers. *Sustainability*, *11*(9), 2532. https://doi.org/10.3390/su11092532

Khalili, N. R., Duecker, S., Ashton, W., & Chavez, F. (2015). From cleaner production to sustainable development: The role of academia. *Journal of Cleaner Production*, *96*, 30–43. https://doi.org/10.1016/j.jclepro.2014.01.099

Kioupi, V., & Voulvoulis, N. (2019). Education for Sustainable Development: A Systemic Framework for Connecting the SDGs to Educational Outcomes. *Sustainability*, *11*(21), 6104. https://doi.org/10.3390/su11216104

Kopnina, H. (2012). Education for sustainable development (ESD): The turn away from 'environment' in environmental education? *Environmental Education Research*, *18*(5), 699–717. https://doi.org/10.1080/13504622.2012.658028

Kras, N. (2022). Nature-Based Learning at an Urban Community College: A Case Study at the Central Park Zoo. *Community College Journal of Research and Practice*, *46*(6), 452–456. https://doi.org/10.1080/10668926.2021.1931557

Kuehl, C., Sparks, A. C., Hodges, H., & Smith, E. R. A. N. (2023). Exploring sustainability literacy: Developing and assessing a bottom-up measure of what students know about sustainability. *Frontiers in Sustainability*, *4*, 1167041. https://doi.org/10.3389/frsus.2023.1167041

Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C. (2016). Contributions of Education for Sustainable Development (ESD) to Quality Education: A Synthesis of Research. *Journal of Education for Sustainable Development*, *10*(2), 226–242. https://doi.org/10.1177/0973408216661442

Liu, H.-Y., Jay, M., & Chen, X. (2021). The Role of Nature-Based Solutions for Improving Environmental Quality, Health and Well-Being. *Sustainability*, *13*(19), 10950. https://doi.org/10.3390/su131910950

Machost, H., & Stains, M. (2023). Reflective Practices in Education: A Primer for Practitioners. *CBE—Life Sciences Education*, *22*(2), es2. https://doi.org/10.1187/cbe.22-07-0148

Mader, C., Scott, G., & Abdul Razak, D. (2013). Effective change management, governance and policy for sustainability transformation in higher education. *Sustainability Accounting, Management and Policy Journal*, *4*(3), 264–284. https://doi.org/10.1108/SAMPJ-09-2013-0037

Mallett, R., Hagen-Zanker, J., Slater, R., & Duvendack, M. (2012). The benefits and challenges of using systematic reviews in international development research. *Journal of Development Effectiveness*, *4*(3), 445–455. https://doi.org/10.1080/19439342.2012.711342

Miedijensky, S., & Abramovich, A. (2019). Implementation of "Education for Sustainability" in Three Elementary Schools – What can we Learn about a Change Process? *EURASIA Journal of Mathematics, Science and Technology Education*, *15*(10). https://doi.org/10.29333/ejmste/109145

Miller, N. C., Kumar, S., Pearce, K. L., & Baldock, K. L. (2022). Primary School Educators' Perspectives and Experiences of Nature-Based Play and Learning and Its Benefits, Barriers, and Enablers: A Qualitative Descriptive Study. *International Journal of Environmental Research and Public Health*, *19*(6), 3179. https://doi.org/10.3390/ijerph19063179

Moallemi, E. A., Malekpour, S., Hadjikakou, M., Raven, R., Szetey, K., Ningrum, D., Dhiaulhaq, A., & Bryan, B. A. (2020). Achieving the Sustainable Development Goals Requires Transdisciplinary Innovation at the Local Scale. *One Earth*, *3*(3), 300–313. https://doi.org/10.1016/j.oneear.2020.08.006

Mogensen, F., & Schnack, K. (2010). The action competence approach and the 'new' discourses of education for sustainable development, competence and quality criteria. *Environmental Education Research*, *16*(1), 59–74. https://doi.org/10.1080/13504620903504032

Müller-Christ, G., Sterling, S., Van Dam-Mieras, R., Adomßent, M., Fischer, D., & Rieckmann, M. (2014). The role of campus, curriculum, and community in higher education for sustainable development – a conference report. *Journal of Cleaner Production*, *62*, 134–137. https://doi.org/10.1016/j.jclepro.2013.02.029

Murray, P. (2012). *The Sustainable Self: A Personal Approach to Sustainability Education*. Routledge. https://doi.org/10.4324/9781849775212

Nabukalu, J. B., Asamani, J. A., & Nabyonga-Orem, J. (2019). Monitoring Sustainable Development Goals 3: Assessing the Readiness of Low- and Middle-Income Countries. *International Journal of Health Policy and Management*, 1. https://doi.org/10.15171/ijhpm.2019.134

Parry, S., & Metzger, E. (2023). Barriers to learning for sustainability: A teacher perspective. *Sustainable Earth Reviews*, *6*(1), 2. https://doi.org/10.1186/s42055-022-00050-3

Paul, P. K. (2019). Information Technology and Computing Programs in the Universities of West Bengal: An Analytical Case Study. *International Journal of Applied Science & Engineering*, *7*(2). https://doi.org/10.30954/2322-0465.2.2019.4

Ramírez Suárez, V., Acosta-Castellanos, P. M., Castro Ortegon, Y. A., & Queiruga-Dios, A. (2023). Current State of Environmental Education and Education for Sustainable Development in Primary and Secondary (K-12) Schools in Boyacá, Colombia. *Sustainability*, *15*(13), 10139. https://doi.org/10.3390/su151310139

Sahin, B. (2025). Advancing Sustainable Development Goal 4 Through Green Education: A Multidimensional Assessment of Turkish Universities. *Sustainability*, *17*(19), 8800. https://doi.org/10.3390/su17198800

Saini, M., Sengupta, E., Singh, M., Singh, H., & Singh, J. (2023). Sustainable Development Goal for Quality Education (SDG 4): A study on SDG 4 to extract the pattern of association among the indicators of SDG 4 employing a genetic algorithm. *Education and Information Technologies*, *28*(2), 2031–2069. https://doi.org/10.1007/s10639-022-11265-4

Serafini, P. G., Moura, J. M. D., Almeida, M. R. D., & Rezende, J. F. D. D. (2022a). Sustainable Development Goals in Higher Education Institutions: A systematic literature review. *Journal of Cleaner Production*, *370*, 133473. https://doi.org/10.1016/j.jclepro.2022.133473

Serafini, P. G., Moura, J. M. D., Almeida, M. R. D., & Rezende, J. F. D. D. (2022b). Sustainable Development Goals in Higher Education Institutions: A systematic literature review. *Journal of Cleaner Production*, *370*, 133473. https://doi.org/10.1016/j.jclepro.2022.133473

Shin, Y., Midgley, G. F., Archer, E. R. M., Arneth, A., Barnes, D. K. A., Chan, L., Hashimoto, S., Hoegh-Guldberg, O., Insarov, G., Leadley, P., Levin, L. A., Ngo, H. T., Pandit, R., Pires, A. P. F., Pörtner, H., Rogers, A. D., Scholes, R. J., Settele, J., & Smith, P. (2022). Actions to halt biodiversity loss generally benefit the climate. *Global Change Biology*, *28*(9), 2846–2874. https://doi.org/10.1111/gcb.16109

Tomaškinová, J., Tomaškin, J., Theuma, H., Alcántara Valero, A. F., & Attard, V. (2021). Addressing Present Challenges in the Life-Cycle of Wetlands Management to Successfully Integrate Sustainability and Good Governance. *Journal of Environmental Engineering and Landscape Management*, *29*(1), 48–60. https://doi.org/10.3846/jeelm.2021.14142

Tundo, P., & Griguol, E. (2018). Green Chemistry for Sustainable Development. *Chemistry International*, *40*(1), 18–24. https://doi.org/10.1515/ci-2018-0105

Ulibarri, N. (2018). Collaborative model development increases trust in and use of scientific information in environmental decision-making. *Environmental Science & Policy*, *82*, 136–142. https://doi.org/10.1016/j.envsci.2018.01.022

United Nations General Assembly. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development (A/RES/70/1)*. United Nations. https://undocs.org/A/RES/70/1.

UNESCO. (2017). *Education for Sustainable Development Goals: Learning objectives*. UNESCO. https://doi.org/10.54675/CGBA9153

Vare, P., & Scott, W. (2007). Learning for a Change: Exploring the Relationship Between Education and Sustainable Development. *Journal of Education for Sustainable Development*, *1*(2), 191–198. https://doi.org/10.1177/097340820700100209

Varela-Candamio, L., Novo-Corti, I., & García-Álvarez, M. T. (2018). The importance of environmental education in the determinants of green behavior: A meta-analysis approach. *Journal of Cleaner Production*, *170*, 1565–1578. https://doi.org/10.1016/j.jclepro.2017.09.214

Venkataraman, B. (2009). Education for Sustainable Development. *Environment: Science and Policy for Sustainable Development*, *51*(2), 8–10. https://doi.org/10.3200/ENVT.51.2.08-10

Wu, Y., Wan, J., & Yu, W. (2023). Impact of environmental education on environmental quality under the background of low-carbon economy. *Frontiers in Public Health*, *11*, 1128791. https://doi.org/10.3389/fpubh.2023.1128791

Zafar, M. W., Shahbaz, M., Sinha, A., Sengupta, T., & Qin, Q. (2020). How renewable energy consumption contribute to environmental quality? The role of education in OECD countries. *Journal of Cleaner Production*, *268*, 122149. https://doi.org/10.1016/j.jclepro.2020.122149

Zikargae, M. H., Woldearegay, A. G., & Skjerdal, T. (2022). Assessing the roles of stakeholders in community projects on environmental security and livelihood of impoverished rural society: A nongovernmental organization implementation strategy in focus. *Heliyon*, *8*(10), e10987. https://doi.org/10.1016/j.heliyon.2022.e10987