The Role of Nature-Based Schools in Advancing the Sustainable Development Goals (SDGs): A Preliminary Study and Literature Review

Aldani P Wijayanti[1], Ezraputi Salsabila[2], Prasetyo Budi Widodo[3], Imam Setyawan[4]

{aldaniwijayanti@lecturer.undip.ac.id[1], ezraputisalsabila99@students.undip.ac.id[2,] prasbudwidodo@gmail.com[3], imam.setyawan@live.undip.ac.id[4]}

Faculty of Psychology, Universitas Diponegoro, Indonesia[1234]

Abstract. Integrating environmental education into formal schooling systems is crucial for fostering sustainable development and ecological stewardship. Nature-based schools, which incorporate outdoor learning and ecological principles into their curricula, are emerging as significant contributors to environmental sustainability and student development. This preliminary study aims to investigate the role of nature-based schools in advancing the United Nations Sustainable Development Goals (SDGs), particularly focusing on quality education (SDG 4), climate action (SDG 13), and life on land (SDG 15). This research employs a comprehensive literature review and initial case studies to examine the educational methodologies in schools, their environmental impacts, and community outcomes associated with nature-based schools. The findings suggest that nature-based schools enhance students' environmental literacy, physical well-being, and social-emotional development manifested from a stronger sense of community. Nature-based schools hold significant potential for contributing to several SDGs by promoting holistic education and connection with the natural world. These outcomes support the broader sustainability objectives envisioned by the SDGs. The need for further research, particularly longitudinal studies and expanded case analyses, is stressed to further validate these findings and explore the scalability of nature-based education in diverse socio-economic contexts.

Keywords: *environmental literacy; nature-based education; outdoor learning; SDGs*

Introduction

In recent years, nature-based education has gained significant attention as an innovative approach to addressing global challenges related to environmental degradation, climate change, and sustainable development. The importance of equipping the younger generation with a deep understanding of ecological principles and sustainable practices has been underscored by a growing body of research (Supriyoko et al., 2022; Chawla, 2021). Nature-based education, which integrates outdoor learning with ecological stewardship, is being recognised as a

ICPSYCHE 2024, July 24-25, Semarang, Indonesia

DOI 10.4108/eai.24-7-2024.2354282

transformative method for developing students' environmental literacy and fostering a sense of responsibility toward the natural world (Becker et al., 2017; Cudworth, 2020).

Numerous studies have documented the benefits of nature-based education for students, highlighting improvements in academic performance, mental well-being, and social skills (Lomax et al., 2024; Wake & Birdsall, 2015). Research shows that students who engage with natural environments demonstrate enhanced cognitive abilities, reduced stress levels, and increased resilience, which are essential qualities for addressing contemporary societal challenges (Kuo & Jordan, 2019; Miller et al., 2022). However, despite these documented benefits, the implementation of nature-based learning on a broader scale remains limited. As Falzon and Conrad (2023) note, there is a lack of structured guidance on how educational institutions, especially those in urban or resource-constrained settings, can design school grounds to facilitate effective nature-based learning experiences.

This study seeks to address a gap in the current literature regarding the role of nature-based education in advancing the Sustainable Development Goals (SDGs), specifically SDG 4 (Quality Education), SDG 13 (Climate Action), and SDG 15 (Life on Land). While the SDGs provide a universal call to action for promoting sustainable practices, there remains a paucity of research on how educational practices can be aligned with these goals to foster environmental literacy and sustainable development among students (Jordan & Chawla, 2022). Consequently, this study aims to explore how school grounds can be designed to support nature-based education, thereby equipping students with the skills and knowledge necessary to contribute to sustainable development.

This research adopts a comprehensive literature review and case analysis approach to achieve these aims. The study contributes to a growing evidence base that supports integrating nature-based learning into school curricula by synthesising existing evidence and identifying effective design elements within educational settings. This research is significant as it provides educators and policymakers with insights into how nature-based education can be implemented in diverse contexts to promote sustainability and ecological stewardship.

Method

This study utilises a *state-of-the-art* review to explore recent developments in nature-based education and its contributions to sustainable development, particularly regarding the United Nations Sustainable Development Goals (SDGs) of Quality Education (SDG 4), Climate Action (SDG 13), and Life on Land (SDG 15). The decision to employ a state-of-the-art review was based on its suitability for providing a comprehensive synthesis of the most recent advancements in a field without the constraints of systematic data extraction (Falzon & Conrad, 2023; Chawla, 2021). This approach allows for an integrative examination of the educational methodologies, environmental impacts, and community outcomes of nature-based schools.

A traditional literature review typically encompasses various forms, each with unique aims. Among these are (a) *Narrative Review*, summarising a broad range of studies without a strict methodological framework, and (b) *Critical Review*, which critiques existing literature to assess the strengths, weaknesses, and research gaps within a field (Miller et al., 2022). This study combines elements of a *State-of-the-Art Review* and an *Integrative Review*, synthesising

findings from diverse perspectives to provide a well-rounded view of nature-based education and its impact on sustainable development (Jordan & Chawla, 2022). Such an approach aligns with previous studies that emphasise capturing a wide array of perspectives to reflect the multi-dimensional nature of educational sustainability initiatives (Supriyoko et al., 2022).

The literature review component of this study was undertaken by consulting multiple databases, including Scopus, SpringerLink, and ProQuest, using keywords such as "*nature-based learning*," "*environmental education*," and "*sustainable school design*." This process allowed for identifying key studies that contribute to a broader understanding of nature-based education's role in fostering ecological literacy and promoting pro-environmental behaviour (Becker et al., 2017; Lomax et al., 2024).

Additionally, existing case studies from the literature were selected to provide contextual insights into the application of nature-based education in real-world settings. These case studies were drawn from primary schools that have implemented nature-based learning environments and whose practices align with sustainable development objectives (Wake & Birdsall, 2015; Kuo & Jordan, 2019). The selection criteria were based on each study's relevance to the research questions and its demonstrated impact on students' engagement with sustainability themes. Case studies illustrate concrete examples of how nature-based schools operationalise ecological principles within their curricula, contributing to students' environmental stewardship.

A narrative synthesis was employed to organise and interpret the findings after selecting relevant studies and case studies. Unlike systematic reviews, which require structured data extraction, a narrative synthesis offers the flexibility to explore thematic insights and examine connections between educational practices and sustainability outcomes (Falzon & Conrad, 2023). This analytical approach enabled a cohesive integration of findings across various studies, revealing recurring patterns and emerging trends in nature-based education. Key themes identified in the literature included the psychological benefits of nature exposure, the enhancement of academic performance, and the development of social skills among students, all of which contribute to a holistic understanding of the benefits associated with this educational model (Cudworth, 2020; Supriyoko et al., 2022).

To maintain academic rigour, the review process prioritised studies published in peer-reviewed journals, focusing on recent publications to ensure that the findings reflect current advancements in nature-based education (Jordan & Chawla, 2022). The integration of qualitative case studies alongside the literature review enhances the robustness of this study by providing real-world applications of theoretical insights, supporting the argument that nature-based education can play a pivotal role in advancing SDGs. Furthermore, attention was given to identifying potential biases in the selected literature, such as regional and socio-economic limitations, which could influence the generalisability of the findings.

Result

The findings of this study underscore the diverse benefits associated with nature-based instruction, particularly its impact on student development and academic achievement. Kuo and Jordan (2019) provide compelling evidence of the positive outcomes of nature experiences in cultivating non-cognitive skills, such as perseverance, self-efficacy, resilience, social skills, leadership, and communication. These are skills that participants identified as being essential

for success beyond traditional educational frameworks. In their article, Kuo and Jordan (2019) highlighted a notable example: a randomised controlled trial involving over 3,000 students, in which those engaged in school garden-based instruction demonstrated significantly greater knowledge gains than students in conventional classroom settings. This finding aligns with broader literature; over 200 assessments of nature-based instruction have consistently shown positive academic outcomes, suggesting that students may derive more substantial benefits from this approach than traditional methods.

In addition to academic advantages, Kuo and Jordan (2019) report that nature-based instruction enhances students' resilience, equipping them to navigate challenges and thrive in adverse conditions. This was reflected in responses from participants who felt that exposure to natural environments boosted their motivation, especially among students less engaged in standard classroom settings. Furthermore, Kuo and Jordan (2019) observed that outdoor activities are linked with higher levels of physical activity and improved cardiorespiratory fitness, which correlate with enhanced academic performance. This view was echoed by Lomax (2024), who reported that natural settings provide a conducive learning environment, enhancing students' capacity for knowledge retention. Lomax (2024) critically assesses the influence of natural environments on the mental health and well-being of children and adolescents, particularly amidst escalating urbanization and rising rates of mental illness. The authors show that encounters with nature typically result in positive mental health outcomes, such as stress reduction and improved cognitive functioning, through a synthesis of many literature reviews and studies. The review identifies three main modalities of nature-based interventions: exposure, interaction, and access, and it classifies "nature" along a continuum ranging from human-engineered areas to pristine natural settings. There is evidence that nature has positive effects, although research on these effects is still limited, especially regarding clinical patients and ethnically diverse groups.

Jordan and Chawla (2022) further contribute to understanding nature-based learning by proposing a coordinated research agenda to support the structured integration of these practices within educational frameworks. Their work emphasises the need for interdisciplinary research and collaboration to maximise the effectiveness of nature-based learning in achieving sustainable educational goals. They argue that nature-based learning can be enhanced through systematic implementation across diverse educational settings, supporting the acquisition of ecological literacy and fostering a commitment to sustainable practices among students. This view aligns with Chawla's (2021) findings on the critical role of outdoor learning in nurturing active citizenship and aligns with global sustainability objectives. As noted in the literature, a structured approach to nature-based learning allows for a more consistent and impactful engagement with sustainability themes, echoing the broader benefits highlighted by other researchers (Jordan & Chawla, 2022; Supriyoko et al., 2022; Kuo & Jordan, 2019).

In a broader context, Chawla (2021) and Miller et al. (2022) provide additional insights into the educational impact of nature-based schools, which embed outdoor learning and ecological principles within their curricula. These studies indicate that students in these environments exhibit enhanced academic outcomes, particularly in critical thinking and problem-solving skills, alongside increased environmental literacy. Participants reported that nature-based education contributed to a deeper understanding of sustainability and ecological balance, fostering environmental stewardship and a sense of community among students. According to

Supriyoko et al. (2022), integrating ecological literacy and sustainable practices within educational frameworks nurtures active citizenship, aligning with global sustainability objectives.

Research by Falzon and Conrad (2023) further underscores the educational value of designing school grounds to support nature-based learning. Their review of evidence reveals that carefully designed outdoor spaces within school environments can facilitate hands-on ecological learning and foster environmental stewardship among students. By transforming school grounds into interactive learning environments, students are not only able to engage directly with nature but are also encouraged to develop a sense of responsibility for ecological preservation. This aligns with findings by Kuo and Jordan (2019) and Lomax et al. (2024), which show that immersive outdoor experiences enhance both cognitive and social outcomes, highlighting the importance of physical environment design in nature-based education.

The role of nature-based solutions (NBS) within educational systems was also emphasised, with studies by Pineda-Martos et al. (2022) suggesting that NBS can effectively strengthen environmental literacy and promote sustainable behaviour. For instance, outdoor learning programmes encouraging hands-on interaction with ecological systems instil a sense of responsibility for environmental preservation. As shown in *Figure 1*, the *Pro-Environmental Behaviour & Nature Based Education Flowchart* illustrates the complex interactions leading to environmentally responsible behaviours, further supporting the view that nature-based education fosters pro-environmental attitudes from an early age.

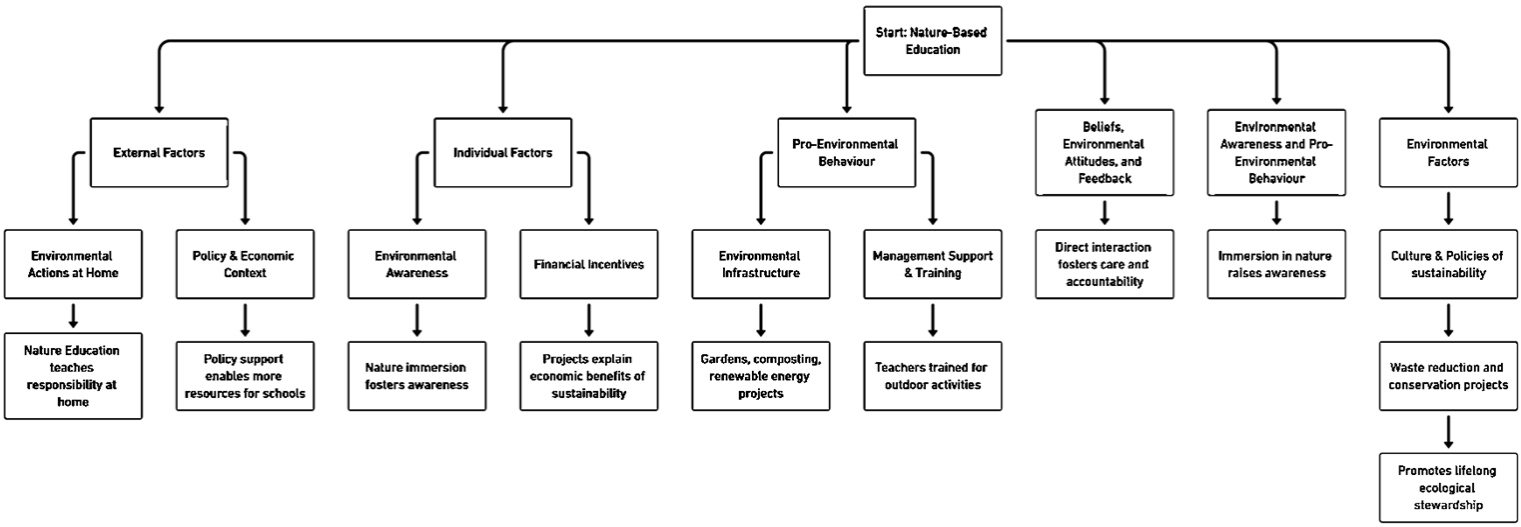

Fig. 1. Pro-Environmental Behavior and Nature-Based Education Flowchart

The flowchart provided are concise summaries derived from the extensive literature review conducted for this study. They encapsulate key insights from various studies, illustrating how nature-based education promotes pro-environmental behaviours and aligns with sustainable development goals.

This flowchart illustrates the diverse factors that contribute to fostering pro-environmental behaviour, each aligning with the fundamental principles of nature-based education. External Factors, such as environmental actions at home and supportive policy and economic contexts, establish a foundational influence on sustainable behaviours, helping to cultivate a sense of responsibility toward ecological preservation. These factors interact with Individual Factors, which include environmental awareness and financial incentives. Together, these external and individual factors foster a personal motivation for sustainability, which nature-based schools harness by immersing students directly in natural settings. This engagement promotes both personal and collective accountability for environmental stewardship.

The flowchart also underscores the significance of environmental infrastructure and management support, where projects like gardens, composting, and renewable energy initiatives act as practical applications of sustainability. Through these elements, students are given opportunities to see the tangible impacts of sustainable practices. Additionally, factors like direct interaction with nature and immersive experiences are shown to elevate environmental awareness, reinforcing pro-environmental attitudes and behaviours among students.

The final layer of the flowchart highlights Environmental Factors, including cultural values and policies that endorse sustainability. These elements encourage activities such as waste reduction and conservation projects, which further support lifelong ecological stewardship. Together, these integrated factors within the framework of nature-based education help cultivate an environmentally conscious mindset, preparing students to become proactive, ecologically responsible citizens.A diverse body of literature explores the multifaceted impact of nature-based learning on child development, environmental awareness, and academic performance. Louv's (2005) seminal work, Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder, argues that children are increasingly disconnected from the natural world, a phenomenon he terms "nature-deficit disorder." Louv contends that this disconnection is detrimental to children's physical and mental well-being, emphasising the need for immersive outdoor experiences as part of childhood education. In contrast, Ernst and Theimer (2011) present empirical findings that measure the effectiveness of environmental education programmes specifically in fostering children's connection to nature. While Louv's work raises concerns on a societal level, Ernst and Theimer's study offers quantitative evidence that participation in structured environmental education programmes significantly enhances children's connection to nature, thus supporting Louv's argument through an empirical lens.

Rickinson and Houghton (2016) critically review the evidence base for environmental education, identifying both strengths and gaps in the existing literature. They find that while many studies support the value of nature-based learning, there remains a need for more rigorous, longitudinal research to substantiate these claims. This need for more robust evidence is echoed by Williams and Dixon (2013), who conducted a synthesis of research on garden-based learning and its impact on academic outcomes. Williams and Dixon's study specifically highlights positive outcomes in science and environmental literacy, thereby complementing Rickinson and Houghton's (2016) call for more structured evidence with concrete examples. Taken together, these studies underscore both the promising potential of nature-based education and the pressing need for ongoing research to validate these findings.

Sobel's (2004) concept of place-based education is an influential framework that connects classrooms with local communities and ecosystems. According to Sobel, place-based education

not only enhances academic learning but also fosters a sense of environmental stewardship and civic responsibility among students. Stern, Powell, and Ardoin (2008) build on Sobel's framework, presenting a model that evaluates the effectiveness of environmental education in schools. Their findings suggest that successful programmes are those that engage students actively and encourage critical thinking about environmental issues, aligning closely with Sobel's emphasis on community connection. However, unlike Sobel, who focuses on the philosophical basis of place-based education, Stern et al. provide a practical framework for measuring its success, highlighting a key methodological advancement in the field.

Townsend and Weerasuriya (2010) investigate the mental health benefits of nature contact, revealing that interactions with green spaces can alleviate stress, anxiety, and depression. This finding aligns with Barrable's (2018) argument that nature connectedness should be a distinct goal in early childhood education, with Barrable suggesting that a sense of connection to nature is critical for fostering holistic development in young children. Both studies suggest that the benefits of nature-based education extend beyond academic outcomes, contributing to broader aspects of health and well-being. However, Barrable focuses specifically on young children and emphasises the developmental importance of fostering nature connectedness from an early age, while Townsend and Weerasuriya address mental health outcomes more generally across age groups.

Barrable and Booth (2020) review various interventions aimed at increasing nature connection in children, noting that structured outdoor activities, such as gardening or ecological exploration, significantly enhance children's environmental engagement and awareness. This finding is consistent with Dillon et al. (2005), who emphasise the educational and social value of outdoor learning within the UK context. Both studies highlight the role of carefully designed programmes in promoting sustainable behaviours, although Barrable and Booth focus more on specific intervention outcomes, while Dillon et al. provide a broader examination of outdoor learning's educational benefits. Together, these findings underscore the importance of intentional, well-supported nature-based programmes in nurturing environmental stewardship from an early age.

Furthermore, the integration of nature-based solutions (NBS) within educational frameworks plays a pivotal role in strengthening environmental literacy and nurturing active citizenship. As Pineda-Martos et al. (2022) highlight, NBS leverage natural processes to address societal challenges, providing an innovative approach for achieving the Sustainable Development Goals (SDGs). Specifically, outdoor learning programmes serve to facilitate deeper engagement with the environment, allowing students to gain practical insights into ecological systems and fostering a sense of responsibility for their preservation (Outdoor Learning and SDGs, 2023). These findings align with those of Lomax et al., who suggest that nature can significantly enhance mental health among younger populations. However, more comprehensive studies are needed to confirm these outcomes definitively. Thus, the broader educational application of nature-based approaches holds considerable promise for fostering holistic development and advancing sustainability goals.

Building on the potential of NBS, incorporating Forest Schools (FS) within educational curricula is also closely associated with promoting pro-environmental behaviour through experiential interactions with nature. Research demonstrates that FS's hands-on learning approach encourages positive attitudes towards the environment, contributing to

environmentally responsible behaviours in later life. Importantly, when FS is fully integrated into the curriculum rather than treated as a standalone activity, it creates a learning environment that fosters a meaningful connection between children and their surroundings, reinforcing their sense of belonging and commitment to environmental stewardship. In this way, integrating FS approaches within nature-based schools advances students' academic and personal growth while aligning educational practices with global objectives, thereby equipping students to contribute meaningfully to a sustainable and equitable world.

In addition, Wake and Birdsall (2015) offer a valuable perspective on the use of school gardens to deepen children's connection to nature. Their review highlights the renewed interest in school gardens across Western countries, where they are increasingly seen as a solution to contemporary issues such as rigid educational systems, rising obesity rates, and reduced interaction with nature. Although school gardens often rely on teacher engagement, community partnerships, and volunteer support, they provide children with opportunities to engage in diverse experiences, from socialisation and play to learning in science and environmental education (Wake & Birdsall, 2015). These findings resonate with previous studies, which underscore the capacity of school gardens to foster positive environmental attitudes and behaviours, particularly when children are actively involved in the planning and design of these spaces. Wake and Birdsall (2015) suggest that this participatory approach has the potential to empower students as "future guardians of the Earth," promoting transformative learning experiences that reinforce environmental stewardship (Jordan & Chawla, 2022; Miller et al., 2022; Pineda-Martos et al., 2022).

Discussion

This article synthesises current findings on the impact of nature-based education on student well-being, environmental literacy, and contributions to the Sustainable Development Goals (SDGs). Compared with traditional education models, which often emphasise structured instruction and academic metrics, nature-based education offers a holistic approach, integrating mental health benefits, environmental awareness, and community engagement. This educational approach fosters cognitive and social development and aligns with global sustainability objectives, highlighting the multifaceted value of embedding ecological principles within educational frameworks (Jordan & Chawla, 2022; Kuo, 2019).

The results consistently indicate that nature-based education positively impacts students' mental well-being, a benefit extensively supported in the literature. For instance, studies have shown that students exposed to natural environments exhibit lower levels of physiological and psychological stress (Li & Sullivan, 2016; Dettweiler et al., 2017). Such findings are in line with SDG 3 (Good Health and Well-being), which underscores the importance of mental health as a foundational component of overall health. Compared with traditional indoor classrooms, nature-based settings allow students to engage in stress-relieving activities, such as unstructured play and exploratory learning, which have been shown to promote resilience and reduce anxiety. These outcomes suggest that integrating natural environments into educational practices could support students' mental health, a crucial component of a sustainable, well-rounded education.

4.1 Nature-Based Education and the Sustainable Development Goals (SDGs)

Nature-based education also aligns with the goals of sustainable development, particularly SDGs 4 (Quality Education), 13 (Climate Action), and 15 (Life on Land). SDG 4 advocates for inclusive and equitable quality education, emphasising the need for lifelong learning opportunities. Nature-based learning environments provide a unique form of inclusive education, accommodating diverse learning styles and promoting social-emotional learning alongside traditional academics (Chawla, 2021; Lomax, 2024). By moving beyond standardised testing and rigid curricula, this approach supports comprehensive student development, addressing the need for an adaptive and inclusive education system that better serves diverse student populations.

Further, the integration of nature-based solutions (NBS) within educational frameworks strengthens environmental literacy, as students directly engage with ecological systems, thereby internalising the importance of sustainability. NBS, as highlighted by Pineda-Martos et al. (2022), leverages natural processes to address societal challenges, aligning closely with SDG 13's emphasis on climate action. By observing and interacting with natural ecosystems, students gain a practical understanding of climate-related issues, an approach that has been found to be more impactful than conventional methods. This direct engagement fosters pro-environmental attitudes and behaviours essential for addressing climate change, thus aligning educational practices with global sustainability goals (Outdoor Learning and SDGs, 2023). Moreover, SDG 15, which focuses on conserving life on land, is inherently supported by nature-based education. Immersive experiences in natural environments cultivate a respect for biodiversity and ecosystem conservation, shaping students' attitudes toward preserving the planet's resources (Wake & Birdsall, 2015). Research suggests that early exposure to nature not only enhances knowledge of ecological concepts but also promotes a lifelong commitment to environmental stewardship (Jordan & Chawla, 2022). Through nature-based education, students develop a lasting connection with the environment, a crucial step toward achieving SDG 15's objectives.

4.2 Broader Societal Implications of Nature-Based Educationtributions to Sustainable Development Goals (SDGs)

In addition to individual and educational benefits, nature-based education has broader societal implications. Nature-based learning can contribute to a cultural shift towards sustainability by nurturing pro-environmental behaviours from a young age. This shift is particularly relevant as society faces increasing environmental challenges, such as climate change and biodiversity loss. The skills and values instilled through nature-based education—such as critical thinking, resilience, and environmental responsibility—are essential for fostering an environmentally conscious generation and proactively addressing global challenges (Miller et al., 2022; Supriyoko et al., 2022).

Studies indicate that students engaged in nature-based education demonstrate higher levels of environmental awareness and a deeper understanding of sustainability principles compared to their peers in traditional settings (Kuo, 2019; Chawla, 2021). This aligns with the notion that exposure to nature encourages attitudes and behaviours conducive to environmental preservation. By fostering environmental literacy and pro-environmental behaviours, nature-based education prepares students to actively contribute to sustainability efforts, both locally and globally, making it a valuable tool in shaping future generations. The beneficial effects of nature on stress reduction have been extensively documented in adults through various

controlled experiments (see Kuo, 2015; Supplementary Material for review), and emerging evidence suggests that these benefits extend to children. Studies consistently show that exposure to natural environments is associated with lower self-reported and physiological stress levels in children (Bell & Dyment, 2008; Chawla, 2015; Wiens et al., 2016). For instance, Li and Sullivan (2016) found that high school students with a view of vegetation from their classrooms experienced significant reductions in heart rate and self-reported stress, unlike those who viewed built environments. Similarly, Dettweiler et al. (2017) demonstrated that students participating in forest-based learning exhibited healthier diurnal cortisol rhythms compared to peers in indoor settings, with cortisol levels decreasing throughout the school day in the forest environment.

These findings have significant implications for mental health and align with Sustainable Development Goal (SDG) 3 (Good Health and Well-being), which emphasises the importance of mental health as a critical aspect of overall health. Nature-based educational environments, support this goal by providing settings that alleviate stress and enhance mental well-being. This approach fosters a more supportive and health-promoting learning environment, helping students develop resilience and coping skills essential for their long-term mental health.

NBS exemplifies a broader alignment with several Sustainable Development Goals (SDGs), highlighting their significance in addressing global challenges. SDG 4 (Quality Education) advocates for inclusive and equitable education that promotes lifelong learning opportunities. Forest Schools contribute to this goal by offering a learning experience that is both inclusive and enriching, addressing students' diverse needs. Their holistic approach integrates academic knowledge with social, emotional, and environmental learning, fostering comprehensive development.

Additionally, methods like Forest Schools advance SDG 13 (Climate Action) by providing students with a robust understanding of climate change and necessary mitigation actions. Direct engagement with natural environments allows students to acquire firsthand knowledge of ecological systems, weather patterns, and the effects of human activity on the planet. This experiential learning approach proves more effective than traditional methods, as it enables students to grasp the real-world implications of their actions and motivates active participation in climate action initiatives.

Furthermore, SDG 15 (Life on Land) is significantly supported by the principles of this connectedness of nature in learning. Immersion in natural habitats will stimulate a deep appreciation for biodiversity and the importance of ecosystem conservation. This early exposure to nature cultivates a lasting sense of wonder and respect for the environment, shaping students' attitudes toward biodiversity and conservation. As a result, a nature-based curriculum contributes to a lifelong commitment to protecting our planet’s diverse ecosystems.

4.3 Challenges Considerations in Implementing Nature-Based Education

Despite its benefits, implementing nature-based education faces several challenges. One of the primary obstacles is the need for adequate infrastructure and suitable physical conditions to support outdoor learning. Many schools may lack access to natural spaces or the resources required to maintain them, limiting the ability to integrate nature-based education into the curriculum.

Additionally, significant challenges relate to the traditional educational mindset, which often prioritises standardised testing and rigid curricula over experiential learning. Teachers, who are key to the successful implementation of nature-based education, may struggle with entrenched beliefs about what education should look like. The lack of institutional support and professional development opportunities for teachers in this area further exacerbates these challenges. Teachers may also face difficulties balancing the existing curriculum's demands with the time and resources needed to implement nature-based programs effectively.

Another consideration is students' psychological vulnerability. While nature-based education can be highly beneficial, it may also pose challenges for students unfamiliar with this learning environment. Educators must be mindful of these challenges and ensure that students receive the support they need to thrive in a nature-based setting. Furthermore, while nature-based education promotes pro-environmental attitudes, it may not be equally accessible to all students. Falzon and Conrad's (2023) review highlights the significant benefits of nature-based learning (NBL) environments, particularly in primary school settings. The study emphasises that well-designed green spaces on school grounds can foster a connection to nature, positively impacting students' mental well-being, cognitive skills, and pro-environmental behaviours. The findings indicate that direct interactions with diverse natural features, such as trees, plants, and water, facilitate enhanced concentration, social engagement, and environmental stewardship. However, Falzon and Conrad also identify notable gaps in current research, especially concerning the specific design features that effectively promote distinct educational and developmental outcomes. They stress the urgent need for empirical studies that offer evidence-based guidance on designing NBL spaces, particularly for urban schools with limited outdoor areas, to ensure equitable access to nature-rich environments across diverse educational contexts Disparities in access to nature can lead to unequal opportunities for engaging with these environments, raising questions about inclusivity and equity in educational reform. Addressing these challenges will require systemic changes in educational policies, as well as community partnerships, to increase access to nature-rich environments for all students.

Conclusion

This study has reviewed the impact and significance of nature-based education on student well-being, environmental literacy, and the promotion of pro-environmental behaviours, particularly as they relate to the Sustainable Development Goals (SDGs). Through an analysis of the literature, it is evident that nature-based educational approaches, such as Forest Schools and school gardens, contribute substantially to holistic child development, fostering essential life skills, and enhancing mental health. By engaging students in immersive outdoor experiences, these models not only support cognitive and emotional growth but also instil a deep connection to the natural world and a commitment to environmental stewardship. This alignment with SDG 3 (Good Health and Well-being), SDG 4 (Quality Education), SDG 13 (Climate Action), and SDG 15 (Life on Land) underscores the value of integrating ecological principles within educational systems to advance global sustainability objectives.

However, several limitations within the study and broader implementation challenges must be acknowledged. This literature review does not encompass new empirical data but relies on a synthesis of existing studies. As a result, while it identifies consistent themes and positive

outcomes associated with nature-based education, further empirical research is needed to validate these findings across diverse contexts and demographics. The generalisability of some results may be limited, as much of the literature focuses on Western educational settings, which may not fully represent the potential of nature-based approaches in varying cultural and ecological environments.

Implementing nature-based education on a broad scale faces several practical challenges, including limited infrastructure, resource constraints, and entrenched traditional educational models. Schools may lack adequate access to natural spaces, and teachers may not receive sufficient support or training to deliver outdoor learning effectively. Additionally, disparities in access to nature-rich environments can lead to inequities in educational opportunities, limiting the inclusivity of nature-based education.

Future research should aim to address these limitations by exploring the impact of nature-based education in more diverse settings, particularly in urban and resource-constrained areas. Studies examining the long-term outcomes of such educational approaches and their scalability within existing educational frameworks would provide valuable insights. Furthermore, policy-level changes and partnerships with community organisations may be necessary to facilitate wider access to nature-based learning for all students, ensuring equitable opportunities to experience and benefit from natural environments.

In conclusion, while nature-based education is promising for fostering pro-environmental attitudes and sustainable behaviours among students, its successful integration requires continued research, policy support, and community collaboration. By addressing these challenges and building on the insights gathered here, educational systems can evolve better to support both individual well-being and global environmental goals, ultimately nurturing a generation equipped to contribute meaningfully to a sustainable and equitable future.

Acknowledgements.

The authors would like to thank the Head of the Sekolah Alam Arridho Foundation and the Headmasters for their participation in the preliminary interview, which provided valuable insights that contributed to our understanding of the literature review on nature-based schools. This study was made possible by a grant from the Faculty of Psychology, Universitas Diponegoro, for the 2024 fiscal year.

Conflict of interest

None.

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