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Nature-Based Learning and Socio-Emotional Competence: Evidence from Elementary Schools in Indonesia

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Abstract. Nature-based learning (NBL) is an innovative pedagogical approach that integrates academic learning, socio-emotional development, and environmental engagement through direct experiences in natural settings. Although previous studies have reported positive effects of NBL on students' well-being and interpersonal skills, empirical evidence remains limited in developing country contexts, particularly in Indonesia,while few studies have compared teacher and student perceptions across specific socio-emotional competence (SEC) domains. This study employed a convergent parallel mixed-method design to examine the impact of NBL on SEC among Indonesian elementary school students. Participants were selected through purposive sampling from three eco-oriented elementary schools, involving 240 participants (80 teachers and 160 fourth-grade students). Quantitative data were collected using validated questionnaires, while qualitative data were obtained through semi-structured interviews. Data were analyzed using descriptive and inferential statistics and thematic analysis, followed by data integration. The findings revealed convergence in social awareness and relationship skills, while significant divergence emerged in self-management, responsible decision-making, and self-awareness, with teachers reporting higher gains than students. Students emphasized enjoyment and emotional well-being as key benefits of NBL. The study concludes that NBL effectively enhances interpersonal competencies; however, it requires structured reflective practices to strengthen intrapersonal development. These results highlight the importance of curriculum integration, teacher professional development, and policy support for equitable access to culturally responsive outdoor learning in Indonesia.

Keywords: nature-based learning; socio-emotional competence; outdoor education; Indonesia

1. Introduction

In the 21st century, education must not only deliver academic knowledge but also cultivate resilience, socio-emotional competence (SEC), and ecological responsibility to prepare students for global challenges such as climate change, biodiversity loss, and social inequalities. Within this paradigm, nature-based learning (NBL) encompassing outdoor education, experiential learning, and "schools in nature" is increasingly recognized as an innovative pedagogy that unites cognitive, socio-emotional, and ecological learning (Miller et al., 2022a; Falzon & Conrad, 2024; Langelier et al., 2025). Recent evidence highlights that direct interaction with nature reduces stress, improves attention and self-regulation, enhances peer relationships, and increases pro-environmental attitudes (Mann et al., 2022; Ríos-Rodríguez et al., 2024; Yan et al., 2024). Studies further suggest that NBL contributes to resilience, mitigates eco-anxiety, and strengthens intrinsic motivation as explained by self-determination (Deci & Ryan, 2017). Collaborative and reflective outdoor learning experiences also support the five domains of SEC self-awareness, self-management, social awareness, relationship skills, and responsible decision-making (CASEL, 2003). These findings position NBL not merely as recreational but also as a transformative model for cultivating 21st-century competencies.

Beyond socio-emotional learning frameworks, the relevance of NBL can also be understood through ecopsychology and transformative learning theory (TLT). Ecopsychology emphasizes the human need for connection with the natural world as a foundation for psychological wellbeing, suggesting that learning in natural settings promotes emotional balance and empathy (Langelier et al., 2025; Miller et al., 2022b). Furthermore, TLT (Mezirow, 2000) highlights how experiential encounters with nature can trigger perspective shifts, leading students to reinterpret their relationship with the environment and with others. Neuroscientific studies also suggest that contact with green spaces stimulates brain regions associated with attention restoration and emotional regulation (Heras et al., 2020; Mann et al., 2022). Together, these perspectives provide a multidisciplinary justification for integrating NBL into modern education. In the Indonesian context, NBL holds particular promise. Cultural values such as *gotong royong (*mutual cooperation*)*, *Maja Labo Dahu* (mutual respect and integrity), and the Pancasila framework of character education resonate strongly with the aims of SEC, particularly in nurturing empathy, social responsibility, and integrity. Embedding NBL into elementary education thus provides opportunities not only to enhance student competencies but also to integrate ecological awareness with cultural identity (Mirrahimi et al., 2011; Murtadlo et al., 2024).

The importance of NBL is also aligned with the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 13 (Climate Action) (Buerkle et al., 2023; Kaloutsa et al., 2025). By exposing students to ecological realities from an early age, NBL cultivates awareness, responsibility, and agency in addressing environmental challenges (Friedman et al., 2023; Jordan & Chawla, 2019; Yan et al., 2024). Furthermore, in the Indonesian context, the introduction of Kurikulum Merdeka emphasizes project-based and experiential learning, providing fertile ground for NBL practices. At the same time, the rise of eco-

anxiety among children and adolescents underscores the urgent need for pedagogical approaches that not only teach about environmental crises but also foster resilience, hope, and proactive engagement (Pratami et al., 2024; Suharni et al., 2025). Despite its potential, the implementation of NBL in Indonesia faces systemic challenges, such as limited teacher training in eco-pedagogy, unequal access to green spaces, and the perception of outdoor learning as extracurricular rather than curricular (Harris, 2023). Nevertheless, Indonesia's ecological richness and cultural traditions offer unique opportunities for NBL. School gardens, local ecological projects, and community-based conservation practices can be integrated into formal education, turning environmental resources into living classrooms. By embedding local wisdom such as *gotong royong* and *Maja Labo Dahu* within outdoor learning, NBL can serve not only as an educational innovation but also as a medium for reinforcing cultural identity and social cohesion (Larimore & Warden, 2024; Lestari et al., 2023).

Nevertheless, research gaps remain significant**.** First, most studies on NBL and SEC have been conducted in Western or high-income countries, leaving a lack of empirical evidence from Southeast Asia, particularly Indonesia, where ecological and cultural conditions differ substantially. Second, earlier works tend to emphasize teachers' or institutional perspectives while neglecting how students themselves perceive and internalize SEC development through outdoor learning. Third, few studies systematically examine how each SEC dimension is differentially shaped by NBL, particularly self-awareness, self-management, and responsible decision-making, which often require structured reflection. Fourth, research has rarely integrated local cultural values and indigenous wisdom into the analysis of NBL, missing an opportunity to contextualize global educational innovations within local traditions (Fauzi et al., 2025; Ratten, 2022). This study addresses these gaps by investigating the role of NBL in fostering SEC among Indonesian elementary school students, incorporating both teacher and student perspectives. The novelty of this research lies in its context-specific evidence from Indonesia, its comparative design capturing perceptions of both teachers and students, its systematic measurement of all five SEC domains along with emotional wellbeing and academic perceptions, and its explicit integration of cultural values such as *gotong royong* and *Maja Labo Dahu* into the discourse on outdoor learning.

Beyond theoretical contributions, this study also offers strong practical relevance. For teachers, it provides insights into how reflective practices and curriculum alignment can optimize outdoor learning. For schools, it informs professional development and eco-pedagogy models to integrate NBL systematically. For policymakers, the findings underscore the importance of green school infrastructure, institutional recognition of outdoor learning, and equity-oriented policies to ensure access across diverse socioeconomic groups. For communities, the study demonstrates how integrating NBL with cultural values creates a culturally responsive pedagogy that strengthens collaboration between schools, families, and local stakeholders. In sum, this research situates NBL as a powerful and culturally grounded approach to strengthening SEC and ecological

responsibility in Indonesian elementary education, while also contributing to the global discourse on sustainable and holistic pedagogy.

Research Questions

The following research questions guide the investigation:

- RQ1: To what extent does NBL enhance students' social awareness and relationship skills?
- RQ2: How does NBL influence students' self-oriented competencies (self-awareness, self-management, and responsible decision-making)?
- RQ3: Are there significant differences between teachers' and students' perceptions of NBL impacts across SEC domains?
- RQ4: How do observational and field note data explain students' socio-emotional development during NBL activities?

Theoretical and Conceptual Framework

This study is grounded in three complementary theoretical perspectives, namely self-determination theory (Deci & Ryan, 2017), transformative learning theory (Mezirow, 2000), and ecopsychology which together explain the psychological, cognitive, and affective mechanisms of NBL in fostering SEC:

- SDT explains how outdoor and nature-integrated experiences satisfy students' intrinsic psychological needs for autonomy, competence, and relatedness, leading to higher engagement and motivation.
- TLT emphasizes reflection and meaning making, suggesting that experiential encounters with nature can trigger shifts in self-awareness and moral reasoning.
- Ecopsychology highlights the human need for connectedness with nature, suggesting that ecological contact enhances empathy, emotional balance, and sense of belonging.

By integrating these frameworks, the study assumes that NBL stimulates social and emotional growth through direct, embodied, and reflective engagement with natural environments, leading to improvements in the five CASEL domains of SEC-self-awareness, self-management, social awareness, relationship skills, and responsible decision-making-along with emotional wellbeing.

2. Methodology

2.1 Research Design

This study employed a convergent parallel mixed-method design in which quantitative and qualitative data were collected simultaneously, analyzed independently, and integrated during interpretation (Creswell & Plano Clark, 2018). This approach enabled a comprehensive examination of the influence of NBL on students' SEC by combining large-scale perception data with in-depth experiential insights. Figure 1 illustrates the overall research procedure, including participant selection, instruments used, data collection stages, analytical strategies, and the integration process. The figure demonstrates how teacher questionnaires, student questionnaires, semi-structured interviews, classroom observations, and field notes collectively contributed to triangulation and meta-inference development.

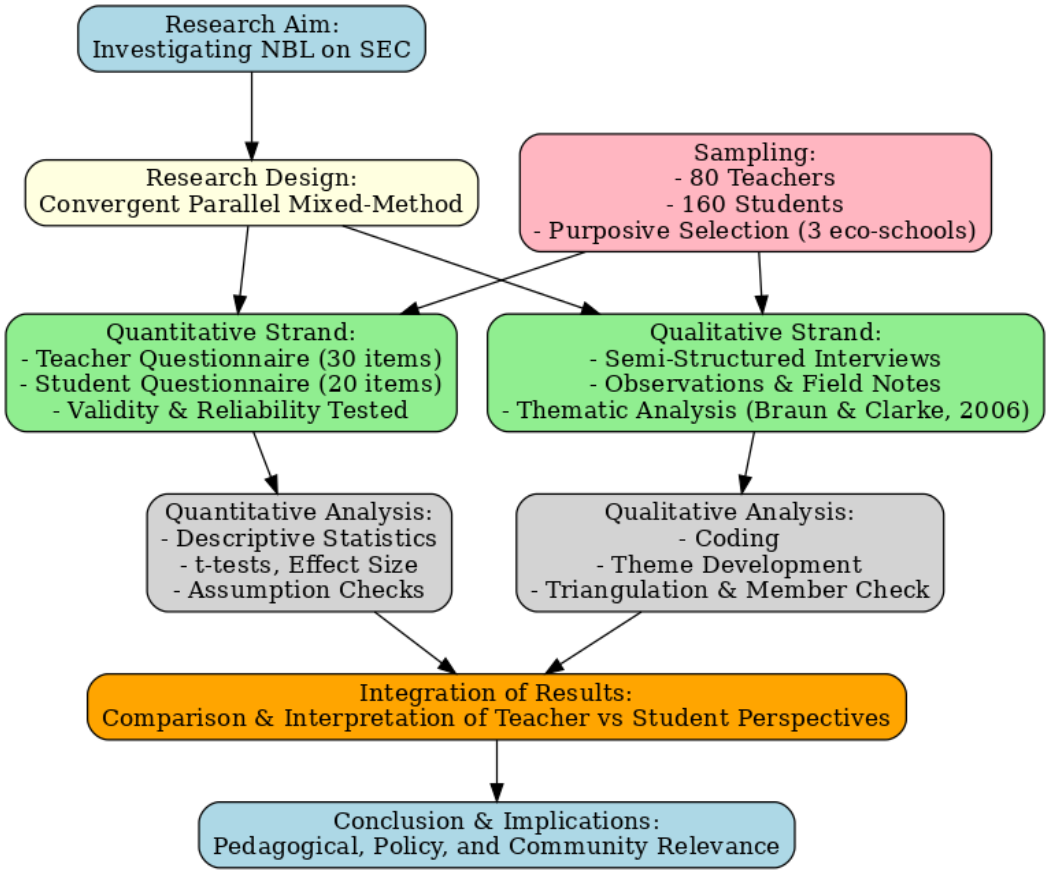

Figure 1: Research Flow of the Convergent Parallel Mixed-Method Design

2.2 Participants and Sampling

Participants consisted of 240 individuals, including 80 teachers and 160 fourth-grade students from three eco-oriented elementary schools in Indonesia that systematically implement nature-based learning practices. A purposive sampling strategy was applied to ensure participants had sustained exposure to NBL environments.

School selection was based on the following:

- Regular integration of outdoor classrooms
- School gardening programs
- Ecological project-based learning

Teacher selection criteria included the following:

- Minimum two years of teaching experience at the school
- Direct involvement in NBL activities
- Voluntary participation

Student selection covered the following:

- All fourth-grade students were invited to participate in surveys (n = 160).
- For qualitative interviews, 20 students were purposively selected based on:
    - Active participation in outdoor activities,

- Gender balance, and
- Teacher recommendations regarding communicative ability.

Interviewed teachers (n = 12) were selected to represent varying years of experience and instructional roles. This differentiated sampling ensured alignment between each data collection instrument and its intended analytical purpose.

2.3 Instruments

Five complementary instruments were employed:

A. *Teacher Questionnaire: A 30-item Likert-scale instrument based on the CASEL SEC framework assessing the following:*
   - Self-awareness
   - Self-management
   - Social awareness
   - Relationship skills
   - Responsible decision-making

B. *Student Questionnaire: A simplified 20-item Likert instrument designed with the following:*
   - Smiley-face visual scales
   - Short, age-appropriate sentences
   - Administration in students' mother tongue (Bahasa Indonesia with local expressions when necessary)

This adaptation was implemented to enhance comprehension among fourth-grade learners.

C. *Semi-Structured Interviews: Conducted with 12 teachers and 20 students to explore the following:*
   - Experiences of NBL
   - Emotional responses
   - Social interactions
   - Perceived benefits and challenges

D. *Classroom and Outdoor Activity Observations to document the following:*
   - Student collaboration
   - Emotional expressions
   - Engagement patterns
   - Self-regulation behaviors

E. *Field Notes*

Captured contextual dynamics, spontaneous interactions, and environmental influences during learning activities.

Table 1: Research Instruments, Domains, and Validation Procedures

Instrument	Description	Domains / Focused Aspects	Validity & Reliability
Teacher Questionnaire	30-item Likert-scale based on the CASEL framework (2020). Each SEC domain represented by 5–6 items (e.g., "Outdoor activities help students manage their emotions effectively").	Self-awareness, self-management, social awareness, relationship skills, responsible decision-making	Content validity by three experts; Cronbach's Alpha = 0.87
Student Questionnaire	Simplified 20-item Likert-scale using smiley-face visual supports to enhance comprehension among fourth-grade students.	Self-awareness, social interaction, responsibility, emotional well-being, enjoyment	Pilot-tested with 20 students; expert-reviewed; Cronbach's Alpha = 0.82
Semi-Structured Interviews	Conducted with a purposive subsample of 12 teachers and 20 students to explore lived experiences of NBL, perceived benefits, and challenges.	Perceptions of NBL, socio-emotional development, learning engagement	Expert-reviewed interview guide; credibility ensured through triangulation and member checking
Classroom and Outdoor Observations	Systematic non-participant observations conducted across multiple NBL sessions to document student behaviors, interactions, and emotional responses.	Collaboration patterns, self-regulation, engagement, peer interaction	Observation protocol validated by experts; inter-observer agreement checks
Field Notes	Reflexive and descriptive notes recorded during and after learning activities to capture contextual factors and spontaneous socio-emotional expressions.	Learning context, environmental influences, emergent behaviors	Audit trail maintained; confirmability strengthened through data triangulation

2.4 Data Collection Procedures

Data were collected over a three-month period.

- Quantitative surveys were administered during scheduled class sessions.
- Research assistants assisted students by reading items aloud when necessary.
- Interviews were conducted in quiet learning spaces or outdoor settings.
- Observations were carried out across multiple NBL sessions.
- Field notes were recorded immediately following each observation.

All data collection followed standardized protocols to ensure consistency.

2.5 Data Analysis

Quantitative data were analyzed using descriptive statistics and group comparisons to examine perceptions across SEC domains. Qualitative data from interviews, observations, and field notes were analyzed through thematic analysis, involving the following:

- Initial coding
- Theme development
- Cross-source triangulation.

Integration occurred through a joint display matrix, aligning numerical trends with qualitative themes to generate meta-inferences.

2.6 Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the State University of Yogyakarta (Ref. No: B/2894/UN34.11/PP/PEN/2025). All participants provided written informed consent, with additional parental consent for student participants. Anonymity and confidentiality were strictly maintained; pseudonyms were used in reporting qualitative excerpts. Participation was voluntary, and respondents could withdraw at any stage without consequence.

3. Results

3.1 Interpretation Criteria

To ensure consistent and meaningful interpretation of the Likert-scale questionnaire results, mean scores were categorized into five performance levels based on equal interval classification across the five-point scale. This approach enables clearer differentiation of perceived impact levels across socio-emotional competence (SEC) domains.

Specifically, the following thresholds were applied:

- 1.00–1.80 = Very low, indicating minimal perceived influence of nature-based learning on the targeted SEC domain
- 1.81–2.60 = Low, reflecting limited developmental impact
- 2.61–3.40 = Moderate, representing moderate improvement
- 3.41–4.20 = High, indicating substantial positive influence
- 4.21–5.00 = Very high, reflecting strong and consistent developmental outcomes.

These categorical interpretations facilitated systematic comparison across domains and between teacher and student perceptions.

To evaluate the magnitude of perceptual differences between groups, effect sizes were calculated using Cohen's d, allowing interpretation beyond statistical significance. Effect size values were classified as the following:

- 0.20 = small effect, indicating minor practical difference
- 0.50 = medium effect, representing moderate practical significance
- 0.80 and above = large effect, reflecting substantial and educationally meaningful differences.

This combined use of mean-level interpretation and effect size analysis provided a comprehensive understanding of both the intensity and practical relevance of NBL's impact on students' SEC.

3.2 Research Question 1

3.2.1 Interpersonal Competencies

Social Awareness and Relationship Skills

Table 2: Mean Scores of Interpersonal SEC Domain

SEC Domain	Min	Max	Mean (M)	SD	Interpretation
Social Awareness	3.0	5.0	4.5	0.52	Very High
Relationship Skills	3.0	5.0	4.5	0.55	Very High
Self-Management	2.5	5.0	4.2	0.61	High
Responsible Decision-Making	2.8	5.0	4.1	0.58	High
Self-Awareness	2.0	5.0	3.9	0.65	Moderate to High

The quantitative findings revealed that both teachers and students reported high to very high levels of improvement in social awareness and relationship skills following the implementation of NBL. These interpersonal domains consistently received the highest mean scores across all SEC components, indicating that NBL was particularly effective in fostering students' abilities to understand others' perspectives, collaborate with peers, and maintain positive social relationships. Teachers emphasized notable growth in students' empathy, cooperative behaviors, and peer support during outdoor learning activities. They observed that collaborative tasks such as group gardening, environmental exploration, and problem-solving in natural settings encouraged mutual assistance and collective responsibility. These authentic social interactions provided frequent opportunities for students to practice perspective-taking and conflict resolution in meaningful contexts.

Similarly, students reported enhanced enjoyment and social engagement when participating in group-based outdoor activities. Many expressed the view that learning in natural environments made it easier to communicate, build friendships, and feel emotionally connected to classmates. The informal and open nature of outdoor spaces appeared to reduce social barriers and promote spontaneous peer interaction, thereby strengthening relationship skills. Overall, the convergence between teacher and student perceptions underscores the strong interpersonal benefits of NBL. By situating learning within collaborative and experiential contexts, NBL effectively nurtures social awareness and relationship skills as core components of SEC. These findings suggest that nature-based pedagogies serve not only as academic enrichment strategies but also as powerful social learning environments that support students' interpersonal development.

3.3 Research Question 2

3.3.1 Intrapersonal Competencies Self-Oriented Domains

Table 3: Mean Scores of Self-Oriented SEC Domains

Dimension	Min	Max	Mean (M)	SD	Interpretation
Social Awareness	3.0	5.0	4.2	0.57	High
Relationship Skills	2.5	5.0	4.3	0.57	High
Self-Management	1.8	4.5	3.2	0.68	Moderate
Responsible Decision-Making	1.5	4.5	3.0	0.70	Moderate
Self-Awareness	1.5	4.0	2.9	0.65	Low to Moderate
Academic Achievement	1.0	4.0	2.8	0.70	Low
Enjoyment/Well-Being	3.5	5.0	4.6	0.48	Very High

The quantitative results indicated moderate to high levels of development in self-awareness, self-management, and responsible decision-making as perceived by teachers. These findings suggest that NBL environments provided meaningful opportunities for students to practice emotional regulation, goal-directed behavior, and personal responsibility through authentic outdoor tasks. Teachers frequently observed students managing their excitement during physical activities, persisting through challenges, and assuming responsibility for shared resources such as gardening tools and environmental projects. In contrast, students reported lower perceptions of growth in these intrapersonal domains, with mean scores remaining within the low to moderate range. This divergence implies that while behavioral changes were visible to educators, students may have lacked sufficient reflective awareness to recognize their own emotional development. Unlike interpersonal skills, which are immediately experienced through peer interaction, intrapersonal competencies often require guided reflection to become consciously internalized.

The discrepancy between teacher and student perceptions highlights an important pedagogical implication: although NBL naturally supports self-regulation and responsibility through experiential learning, intentional reflective practices such as journaling, group debriefing, or emotional check-ins are essential to strengthen students' self-awareness. Without structured opportunities to process experiences, intrapersonal growth may remain implicit rather than explicitly recognized by learners. Overall, these findings indicate that NBL effectively promotes foundational self-oriented competencies at the behavioral level, yet its impact on students' conscious emotional understanding can be enhanced through reflective instructional strategies.

3.4 Research Question 3

3.4.1 Comparative Perceptions Between Teachers and Students

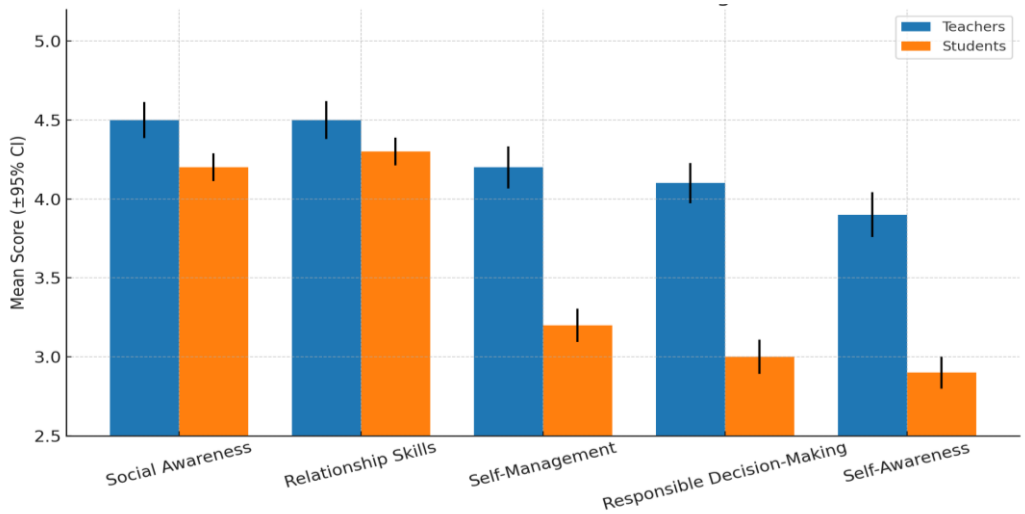

Figure 2: Comparison of Mean SEC Scores across Domains

The comparative analysis of mean scores across SEC domains revealed a clear pattern of convergence in interpersonal competencies and divergence in self-oriented competencies between teachers and students. Both groups consistently rated social awareness and relationship skills at high to very high levels, indicating shared recognition of the strong social benefits of NBL. This convergence suggests that interpersonal growth is immediately observable and experientially salient for both educators and learners within collaborative outdoor learning contexts. In contrast, substantial divergence emerged in self-awareness, self-management, and responsible decision-making. Teachers consistently reported moderate to high developmental gains in these domains, whereas students perceived only low to moderate improvement. This discrepancy highlights the difference between externally observable behavioral regulation and students' internal emotional awareness. Teachers were able to identify improvements in students' perseverance, emotional control, and responsibility during NBL activities, while students may not have consciously recognized these intrapersonal changes without guided reflection.

The comparative pattern underscores an important educational implication: interpersonal competencies develop more transparently through social interaction, while intrapersonal competencies require intentional scaffolding to become cognitively and emotionally meaningful to learners. These findings reinforce the value of combining experiential outdoor learning with reflective pedagogical strategies to ensure balanced development across SEC domains. Overall, the convergence and divergence trends demonstrated in Figure 3 illustrate the complementary perspectives of teachers and students in evaluating NBL outcomes, providing a more comprehensive understanding of its multifaceted impact on socio-emotional development.

3.5 Research Question 4

3.5.1 Observational and Field Note Analysis

Qualitative analysis of classroom observations and field notes yielded three interrelated themes that illuminate how NBL facilitated students' socio-emotional development in authentic contexts. These themes provide contextual depth to the quantitative findings by capturing students' lived experiences and behavioral expressions during outdoor learning activities.

Theme 1: Strengthened Peer Collaboration

Observational data revealed frequent instances of cooperative problem-solving and shared task responsibility among students during nature-based activities. Group gardening projects, environmental exploration tasks, and outdoor science investigations required students to coordinate roles, negotiate decisions, and support peers who encountered difficulties. Field notes documented students spontaneously offering assistance, sharing tools, and collectively planning task completion.

For instance, one field note recorded: *"When one student struggled to dig the soil, two classmates immediately took turns helping without being asked, while another student organized the tools so everyone could continue working efficiently." (Field Note, Session 2)*

This behavior reflects emerging empathy, leadership, and collective responsibility fostered through collaborative outdoor learning. For example, during a planting activity, several students reorganized group roles when one peer struggled with soil preparation, ensuring task completion without teacher intervention. Such moments reflected the development of empathy, leadership, and mutual accountability. These collaborative behaviors were consistently observed across different NBL sessions, indicating that the natural learning environment fostered sustained peer interaction rather than isolated cooperation. This theme strongly aligns with the high quantitative scores in social awareness and relationship skills, illustrating how interpersonal competencies were actively practiced and reinforced through experiential learning.

Theme 2: Positive Emotional Engagement

Field notes consistently recorded heightened levels of enthusiasm, curiosity, and emotional expressiveness during outdoor learning compared to traditional classroom instruction. Students frequently displayed excitement when exploring natural materials, participating in physical movement, and engaging with real-world environmental phenomena. Verbal expressions of enjoyment, laughter, and spontaneous questioning were common features of NBL sessions.

One observation noted: "*Several students who were usually quiet in the classroom became more talkative and enthusiastic outdoors, laughing while collecting leaves and excitedly sharing their discoveries with peers." (Field Note, Session 4)*

This emotional engagement appeared to reduce learning-related anxiety and enhance social participation. In several instances, students who were typically reserved in classroom settings appeared more communicative and socially

engaged outdoors. Observers also noted reduced signs of academic anxiety, such as restlessness or withdrawal, suggesting that the natural environment created a psychologically safe space for emotional participation. This positive emotional climate appeared to enhance students' willingness to collaborate, take learning risks, and persist in tasks, thereby indirectly supporting both interpersonal and intrapersonal development.

Theme 3: Emerging Self-Regulation

Although less pronounced than interpersonal growth, observational evidence indicated early development of self-regulation and emotional control during challenging NBL activities. Students were observed managing frustration when tasks required physical effort, patience, or problem-solving persistence—such as navigating uneven terrain, maintaining focus during planting routines, or completing group challenges.

As recorded in the field notes: *"After becoming frustrated when the plant seedlings fell over, a student paused, took a deep breath, and tried again instead of giving up, while a peer encouraged him to continue." (Field Note, Session 5)*

Such moments illustrate developing emotional regulation and perseverance within experiential learning contexts. Field notes described moments where students paused to calm themselves, sought peer support rather than abandoning tasks, and demonstrated increasing tolerance for delayed outcomes. For instance, during a composting activity that initially failed to produce visible results, students expressed disappointment but gradually learned to persist through repeated trials. These behavioral indicators suggest that NBL supported foundational self-management skills at an experiential level, even though students may not yet consciously recognize these competencies.

3.6 Integrative Interpretation

The integration of quantitative and qualitative findings provides a comprehensive understanding of how NBL influences students' SEC. Across both data strands, a consistent pattern emerged in which interpersonal competencies developed more rapidly and visibly than intrapersonal competencies. High mean scores in social awareness and relationship skills were substantiated by rich observational evidence of frequent peer collaboration, empathetic interactions, and shared responsibility during outdoor learning activities. These convergent findings indicate that the social structure of NBL environments inherently promotes continuous interpersonal engagement, creating repeated opportunities for students to practice and internalize prosocial behaviors. In contrast, intrapersonal competencies such as self-awareness and self-regulation exhibited more moderate quantitative gains and subtler qualitative manifestations. While teachers observed behavioral indicators of emotional control and responsibility, students' lower self-reported perceptions suggest that these competencies remained largely implicit. The experiential challenges embedded in NBL such as managing physical effort, overcoming frustration, and persisting through task difficulties served as natural contexts for developing self-regulation; however, without explicit reflective scaffolding, students may not consciously recognize or cognitively process their emotional growth.

This divergence highlights an important pedagogical mechanism underlying NBL outcomes. Whereas interpersonal development is directly reinforced through social interaction and immediate feedback from peers, intrapersonal growth requires intentional reflective practices to transform experience into emotional understanding. Activities such as guided discussions, reflective journaling, and emotional check-ins could therefore strengthen students' awareness of self-oriented competencies and enhance the long-term impact of NBL on holistic development. The integrative analysis confirms that NBL functions as a powerful experiential learning environment that naturally fosters social connectedness while simultaneously offering latent opportunities for intrapersonal growth. By strategically combining outdoor experiential activities with structured reflection, educators can maximize the balanced development of both interpersonal and intrapersonal dimensions of SEC.

4. Discussion

The findings of this study indicate that NBL significantly enhances students' social awareness and relationship skills, with both teachers and students consistently reporting high to very high improvements across these interpersonal domains. This pattern aligns closely with previous research demonstrating that outdoor and experiential learning environments promote empathy, cooperation, peer support, and collaborative problem-solving (Kim et al., 2025; Salimi et al., 2020; Walshe et al., 2025). Similar to the present results, Walshe et al. (2025) found that sustained engagement in nature-centered activities strengthened students' social connectedness and sense of belonging, while Lanza et al. (2023) reported positive associations between contact with nature and children's socio-emotional learning outcomes. The strong convergence between teacher and student perceptions in this study further supports earlier evidence that interpersonal competencies are among the most immediately observable and experientially salient outcomes of NBL (Lanza et al., 2023; Siegler et al., 2022). Through collaborative outdoor tasks such as gardening, environmental exploration, and group problem-solving, students are repeatedly exposed to authentic social interactions that naturally foster empathy, communication, and shared responsibility. These findings reinforce the growing consensus in the literature that NBL functions as a powerful social learning environment, where interpersonal development is continuously activated through embodied and cooperative experiences.

Another critical insight from this study concerns the emotional wellbeing associated with outdoor learning. Students rated enjoyment and positive affect very highly, often above their perceptions of academic outcomes. This supports previous evidence that contact with nature enhances wellbeing, reduces stress, and improves overall school satisfaction (Germinaro et al., 2022; Molyneux et al., 2023). In contrast, teachers emphasized motivation and engagement, interpreting outdoor enjoyment as a gateway to improved academic performance. This dual perspective highlights the complementary roles of affective and cognitive benefits in nature-based learning, suggesting that enjoyment should not be seen as secondary but as a vital precondition for sustained motivation and resilience in learning. Taken together, these findings indicate that nature-based learning serves

as an integrated platform for developing SEC. While its social and emotional benefits are clearly recognized, the academic and regulatory dimensions require more explicit scaffolding. By aligning teacher strategies with student experiences, educators can ensure that outdoor learning environments maximize both affective and cognitive growth.

The evidence suggests that NBL enhances SEC through three intertwined mechanisms:

- Embodied Interaction - Outdoor experiences activate multisensory engagement, promoting mindfulness and emotional regulation.
- Collaborative Problem-Solving - Shared physical tasks cultivate empathy, perspective-taking, and cooperative communication.
- Reflective Meaning-Making - Structured discussions and journaling transform raw experiences into personal insights, aligning with Mezirow's concept of transformative reflection.

These mechanisms explain why NBL not only improves social connectedness but also serves as a foundation for moral reasoning and ecological consciousness – two essential aspects of holistic education. The findings of this study can also be understood through the lens of *Maja Labo Dahu* – a Bimanese moral philosophy emphasizing mutual respect, integrity, and humility – and *Gotong Royong*, the Indonesian ethos of collective cooperation. Both values align with the aims of SEC, particularly in fostering empathy, shared responsibility, and ethical decision-making. In outdoor learning settings, these cultural principles are not merely abstract but manifest in daily practices:

- Students collaboratively manage the school garden, embodying *gotong royong* through teamwork and peer care.
- Reflection sessions guided by teachers emphasize honesty and respect (*maja labo dahu*) when discussing emotions, mistakes, and interpersonal challenges. Such integration of local wisdom grounds NBL within the moral ecology of Indonesian society, reinforcing that socio-emotional education is culturally embedded, not imported.

Therefore, embedding *Maja Labo Dahu* within NBL pedagogy not only strengthens cultural identity but also promotes sustainable character education in line with *Pancasila* and the SDGs. Beyond its empirical contributions, this study extends socio-emotional learning and experiential learning theory by demonstrating that NBL environments function as relationally intensive learning spaces that accelerate the development of interpersonal competencies, while intrapersonal competencies require intentional reflective scaffolding to emerge more fully. While previous research has broadly suggested positive socio-emotional outcomes of outdoor learning, the present findings clarify differential developmental pathways across SEC domains, highlighting that social awareness and relationship skills are naturally activated through collaborative ecological tasks, whereas self-awareness and self-regulation develop more gradually through guided reflection. This conceptual distinction advances understanding of how

experiential contexts mediate socio-emotional growth within sustainability-oriented pedagogy.

4.1 Pedagogical Implication

The findings from this study carry important pedagogical implications for the integration of NBL within elementary school education. Both teachers and students acknowledged the social and emotional benefits of outdoor learning, yet differences in perceptions reveal the need for intentional pedagogical strategies to fully realize its potential. First, the results underscore the importance of embedding structured reflection activities into outdoor sessions. While teachers observed improvements in self-management and responsible decision-making, students did not always recognize these competencies. Reflection journals, guided discussions, and peer feedback could bridge this perception gap by making learning outcomes more explicit. This aligns with prior research indicating that reflective practice is crucial for transforming experiential activities into long-term personal competencies (Flynn, 2024; Zulfikar & Mujiburrahman, 2018).

Second, the integration of outdoor learning into the formal curriculum is essential. Teachers noted that nature-based activities are most impactful when connected to academic content, such as science, social studies, or local culture. For instance, lessons on ecosystems become more meaningful when students directly observe plant and animal interactions, while cultural values can be reinforced through traditional ecological knowledge embedded in outdoor practices. Such curricular alignment ensures that outdoor learning is not seen merely as recreational but as a legitimate and powerful instructional strategy.

Third, the findings highlight the necessity of teacher training and professional development in eco-pedagogy. Teachers expressed concerns about logistical challenges, lack of pedagogical models, and insufficient institutional support. Providing targeted training programs can equip teachers with strategies for managing outdoor classrooms, integrating environmental themes into subjects, and assessing student growth in both cognitive and socio-emotional domains. As suggested by Campbell et al. (2025), Jarvis (2021), and Vlčková et al. (2019), sustainable implementation of outdoor education depends largely on teacher confidence and institutional commitment.

Fourth, the study points to the role of collaborative partnerships between schools, families, and communities. Outdoor learning often requires resources, safe environments, and extended support networks. Involving parents in school-based environmental projects or collaborating with local community groups can enhance resource availability and strengthen the sense of shared responsibility for ecological stewardship. Such partnerships not only extend the impact of outdoor learning but also reflect cultural values of collective responsibility and mutual care, which are particularly relevant in the Indonesian context.

Finally, the contrasting perspectives between teachers and students regarding academic outcomes versus enjoyment suggest the need for balanced pedagogical approaches. While teachers focus on curricular objectives, it is equally important

to preserve the joy and freedom students associate with outdoor learning. Pedagogical models should therefore embrace a dual aim: leveraging the motivational power of enjoyment while also guiding students toward explicit cognitive and behavioral competencies. In summary, the pedagogical implications emphasize that NBL requires careful design, intentional integration into the curriculum, teacher preparedness, and community collaboration. By addressing these areas, educators can transform outdoor learning into a sustainable and impactful approach that enhances both socio-emotional and academic development.

4.2 Policy Implications

The findings of this study carry important policy implications for advancing sustainable education in Indonesia, particularly in alignment with specific SDGs. First, the demonstrated impact of NBL on students' social awareness, relationship skills, and emotional wellbeing directly supports SDG 4 (Quality Education) by promoting holistic learning environments that foster both academic and socio-emotional development. Integrating NBL into national curricula can enhance student engagement while nurturing essential life competencies for sustainable societies.

Second, the strong interpersonal outcomes observed in this study contribute to SDG 3 (Good Health and Wellbeing), as positive emotional engagement and reduced learning-related anxiety are foundational to children's mental health. Education policies that encourage outdoor experiential learning can therefore serve as preventative strategies for promoting psychological resilience and well-being among students.

Third, by embedding environmental interaction within learning processes, NBL aligns with SDG 13 (Climate Action) and SDG 15 (Life on Land) through fostering environmental awareness, responsibility, and pro-environmental behaviors from an early age. Policymakers should support school-based sustainability programs that connect ecological stewardship with socio-emotional learning outcomes.
To operationalize these goals, educational authorities should develop curriculum guidelines that formally incorporate NBL, allocate funding for outdoor learning infrastructure, and provide professional development programs that equip teachers with experiential and reflective pedagogical skills. Such policy-level commitments can ensure equitable access to nature-based education while advancing national sustainability agendas.

5. Conclusion

This study examined the role of NBL in fostering SEC among elementary school students. The findings demonstrated that teachers strongly perceived outdoor and nature-integrated activities as effective in enhancing social awareness, relationship skills, self-management, and responsible decision making. Students also reported higher levels of motivation, engagement, and enjoyment during outdoor learning, though their recognition of specific competencies was less explicit compared to teachers. The results suggest that nature-based learning offers significant potential as a pedagogical approach that simultaneously

supports cognitive development, emotional wellbeing, and ecological awareness. By bridging the classroom with the natural environment, students not only strengthen their socio-emotional skills but also develop deeper connections to environmental sustainability. From a practical standpoint, this study highlights three key implications:

- Pedagogical integration - Outdoor learning should be systematically embedded within the curriculum through reflective practices and subject alignment.
- Policy support - National and local education authorities must institutionalize environmental learning by investing in green school infrastructure, developing evaluation frameworks, and ensuring equitable access across socioeconomic backgrounds.
- Community engagement – Effective implementation requires collaboration between teachers, parents, and communities to sustain meaningful and culturally relevant experiences.

Despite its contributions, the study was limited by its single-site scope, reliance on self-reported data, and a cross-sectional design. Future research should expand to multiple contexts, adopt longitudinal and mixed-method approaches, and explore the roles of school leaders, parents, and policymakers to capture systemic dynamics. In conclusion, NBL has the potential to transform elementary education by cultivating SEC and ecological responsibility in students. With a stronger pedagogical design, supportive policies, and inclusive practices, this approach can contribute not only to improved educational outcomes but also to the broader goals of sustainability, resilience, and social cohesion in the 21st century.

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