ESD and Critical Thinking in Science and Social Studies Learning for Grade IV Elementary School

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Abstract: Education for Sustainable Development (ESD) and critical thinking have been incorporated into elementary school Science and Social Studies (IPAS) learning; however, this integration remains limited. This study describes the application of ESD principles and examines the development of critical thinking in fourth-grade IPAS learning using a qualitative case study approach involving six fourth-grade teachers in Moyudan District, Sleman. Data were collected through interviews, classroom observations, and document analysis, and were analyzed using Miles and Huberman's (1984) framework. The results indicate that ESD integration is confined to the IPAS subject and has not yet influenced broader school programs or culture. Students' critical thinking competencies developed unevenly, with the information analysis indicator emerging as the most prominent (43.7%), while the reflection on perspectives indicator showed no development. Limited use of worksheets further constrained students' independence, increasing their reliance on teacher guidance. These findings suggest that a whole-school strategy, the provision of problem- and project-based learning resources, and stronger institutional support are necessary. In addition to offering practical insights for educators, this study demonstrates that Indonesian elementary schools continue to prioritize analytical skills in the implementation of ESD.

Keywords: critical thinking, elementary school, ESD, science and social studies learning

Introduction

Primary education plays a crucial role in preparing a generation capable of critical thinking and an awareness of their interests. Critical thinking is one of the competencies developed through Science and Social Sciences (IPAS in the Indonesian context) learning in elementary schools, and it is typically measured in the National Assessment. A crucial component of Education for Sustainable Development (ESD), which promotes the accomplishment of the Sustainable Development Goals (SDGs), especially SDG 4 on quality education, this competency is evaluated globally as well through the Program for International Student Assessment (PISA) (Gómez & Suárez, 2020; UNESCO, 2017). Indonesia has integrated ESD into the National Curriculum since 2013, and the Merdeka Curriculum provides schools with the flexibility to adapt its principles (UNESCO, 2021; Shabrina et al., 2024). However, the implementation of ESD at the elementary school level remains limited (Gunansyah et al., 2021; Suwarto et al., 2021). The 2022 PISA results, which also monitor progress towards SDG 4, indicate that over 70% of Indonesian students remain in the low-ability category (OECD, 2024). Students still lack essential reading, analysis, and critical presentation skills, according to data from the 2024 National Assessment (Education Standards, Curriculum, and Assessment Agency, 2024). Similarly, research shows that critical thinking skills among elementary school students are relatively low (Setyawan & Mustadi, 2020). Yet, critical thinking is crucial for addressing global issues (Arslan & Curle, 2024), including various disputes in the context of ESD (Ivada, 2024; Munkebye et al., 2020). This helps students develop a thorough understanding of diverse ESD issues (Natori et al., 2025). Developing

critical thinking skills in elementary school is essential to meet global standards, as there is no apparent gap.

Extensive research has been conducted on ESD implementation, focusing on various aspects. These include projects centered on holistic learning (Down & Down, 2018), whole-school approaches (Bosevska & Kriewaldt, 2020; Ron et al., 2020; Sasaki et al., 2024), environmentally conscious schools such as Adiwiyata (Kartini, 2024; Suwarto et al., 2021; Gunansyah et al., 2021), and strengthening action competencies at the secondary level (Olsson et al., 2022). Recent studies have emphasized the importance of project-based platforms to support ESD implementation within the Merdeka Curriculum (Rosmiati et al., 2025), as well as strengthening systems thinking within the context of ESD in both Indonesian elementary schools (Suryani & Hamdu, 2025; Mulyadiprana et al., 2024) and Chinese secondary schools, which demonstrate students' low ability to connect the environmental, social, and economic aspects (Li & Li, 2023). Several studies have also highlighted the effectiveness of longitudinally strengthening students' action competencies (Olsson et al., 2022) and the role of teacher dispositions, particularly critical-thinking tendencies, as key factors in ESD success (Felix, 2023). Only about 25% of elementary school teachers can develop ESD-based critical thinking assessment rubrics, and most struggle with ESD implementation (Herdianti et al., 2023). Consequently, there is a dearth of research on how Indonesian elementary school teachers integrate ESD into IPAS learning while promoting critical thinking.

ESD research has been highly sought after from 1998 to 2024 as a strategic endeavor in educational research to prepare future generations to address sustainability challenges (Ivada, 2024). Since 2014, UNESCO's Global Action Program (GAP) has developed and improved ESD actions at various educational levels through an international conference held in Japan (UNESCO, 2018). Various UN member states have agreed to enhance ESD actions in learning across all types of education (UNESCO, 2020). More than five hundred GAP stakeholders, including institutional leaders, policymakers, focal authorities, youth, educators, and civil society organizations, have pledged to implement ESD as a priority action (UNESCO, 2018). However, changes in student values and behavior resulting from ESD practices in schools are difficult to measure for sustainability (UNESCO, 2023). The measurement of ESD implementation effectiveness is hampered by the absence of a comprehensive evaluation and monitoring system in schools (Abidin et al., 2024). Therefore, more research on ESD practices in education is required, particularly at the elementary school level.

In this context, this study examines how teachers implement Education for Sustainable Development (ESD) principles in IPAS learning for fourth-grade students in the Moyudan District, Sleman Regency, and how they foster students' critical thinking skills within integrated IPAS learning at the elementary level. Furthermore, this study contributions: (1) to provide an overview of how teachers in the Moyudan District of Sleman Regency implement ESD principles and develop critical thinking competencies in IPAS learning for grade IV elementary school students; (2) to offer recommendations for implementing ESD and enhancing students' critical thinking skills in grade IV IPAS learning that teachers can adopt; and (3) it presents examples of ESD implementation and the development of critical thinking competencies in learning applicable to schools in Indonesia.

Methods

The case study research used in this study is qualitative. The research was conducted from February to May 2025 in six elementary schools in Moyudan District, Sleman Regency, Special Region of Yogyakarta. The data collected in this study included primary and secondary data. Primary data were obtained through interviews with six Grade IV elementary school teachers and by documenting IPAS learning activities across various topics, integrating ESD and critical thinking principles. Secondary data included the learning objective for IPAS learning phase B, the Independent Curriculum IPAS textbook, the 1st-semester IPAS worksheet, and the 2nd-semester IPAS worksheet.

Participants in this study were selected using purposive sampling. The criteria for research participants include: (1) grade IV teachers in Moyudan District; (2) have implemented the Merdeka Curriculum; (3) have at least three years of teaching experience; (4) use the Merdeka Curriculum IPAS book published by the Ministry of Education and Culture; and (5) utilize the IPAS student worksheet as a source of student learning. In this study, the data collection techniques employed included semi-

structured interviews, observations, and documentary studies. Semi-structured interviews were conducted with six grade IV elementary school teachers to explore the application of ESD principles and the development of students' critical thinking competencies. Non-participant observations were conducted over two lesson hours to examine the IPAS learning process, using ESD principles and essential indicators of thinking, as documented in structured observation sheets. Documentation studies were conducted on the Merdeka Curriculum IPAS textbook, the semester 1 IPAS student worksheet, and the semester 2 IPAS student worksheet to analyze critical thinking indicators developed in learning IPAS for grade IV elementary school. The documentation study was conducted by reading and analyzing the Independent Curriculum IPAS textbook, the semester 1 IPAS worksheet, and the semester 2 IPAS worksheet. After that, study the critical thinking theme content in the IPAS textbook and both worksheets.

The ESD implementation instrument in IPAS learning for grade IV elementary school was adapted from Ferguson et al. (2021) and Timm & Barth (2020), which are presented in Table 1. Meanwhile, the critical thinking competency development instrument was adopted by UNESCO (2017) and Khasanah et al. (2025) from those presented in Table 2 below.

Table 1. Instruments for Implementing ESD Principles

No.	ESD Principles	Indicators
1.	Approach	Using an interdisciplinary approach
		Integrating ESD into school programs and culture using a whole-school approach
2.	Teaching materials	Understanding the interrelationships among economic, environmental, and social aspects is crucial, as these three dimensions mutually influence one another.
		Relating the material to real issues around students
		Linking materials to local needs
3.	Learning process	Make students actively participate in the learning process
		Encourage students to think critically and solve problems
		Developing positive values and attitudes towards sustainability, such as a sense of responsibility, empathy, and awareness of environmental and social concerns.

Table 2. Critical Thinking Competency Instrument in the Context of ESD

No.	Aspects	Indicators
1.	Question norms, practices, and opinions	Expressing ideas and opinions clearly and in a structured manner
		Analyze and evaluate information from various sources Making logical conclusions based on existing data and evidence
2.	Reflect on values, perceptions, and actions	Identify the problems or challenges faced
		Comparing and contrasting different arguments or perspectives Reflect on one's thoughts and actions, and acknowledge errors or biases
3.	Take a position in the sustainability discourse	Finding creative and effective solutions to existing problems

The data analysis procedure in this study refers to the technique developed by Miles and Huberman (1984). The stages in the data analysis procedure include: (1) organizing data into separate lists based on critical thinking themes and biodiversity issues; (2) compiling a category matrix and placing data according to relevant classifications; (3) compiling analysis tools such as flowcharts to examine the relationships between data; (4) tabulating the frequency of occurrence of various events; (5) analyzing the complexity of the data through statistical calculations such as the percentage of critical thinking themes and biodiversity issues; and (6) compiling data chronologically or using other time frames to clarify the sequence of events.

Results and Discussion

Results

The ESD Principles in IPAS Learning for Grade IV Elementary School

Interviews and learning observations indicate that the evaluation of ESD implementation in Grade IV IPAS learning has successfully incorporated ESD principles in the learning approaches, teaching materials, and learning processes. However, not all ESD principles are implemented optimally. The first principle of the ESD approach implemented in the six elementary schools in the Moyudan District is an interdisciplinary method that integrates natural and social sciences within a single subject. However, this approach has not been specifically integrated into the school's programs or culture using a whole-school strategy. Thus, the use of an interdisciplinary approach to indicator 1 of the ESD approach principle is the only one that has been met.

The second principle is that the IPAS teaching materials for grade IV elementary school students include Indicator 1, which emphasizes understanding the connections among economic, environmental, and social aspects, and how these three areas interact. However, two elementary schools tended to emphasize social and economic dimensions in their instruction. This was because the main topic covered in IPAS lessons at that time was cultural diversity in Indonesia. Unlike the other four elementary schools, which had incorporated all three ESD elements into their IPAS lessons, the lessons at that time focused on how the landscape affected people's livelihoods and natural resources, as well as on "me and my needs." Furthermore, indicators 2 and 3 of the IPAS teaching material principles have also been fulfilled. Real concerns about students and local needs, both in the school setting and in the family and community, have been linked to grade VI elementary school IPAS teaching materials. An example of applying the principles of IPAS teaching materials is shown in Figure 1.

Figure 1. The Application of ESD Principles in Teaching Materials

Students learn about the social, economic, and environmental aspects and how these three aspects influence human life, as illustrated in Figure 1, which shows the relationship between landscape and natural resources, through group discussions. Each group analyzes the influence of landscape on natural resources and the livelihoods of local communities and other regions in Indonesia. This aligns with the application of the three indicators of the second ESD principle. Implementing this principle aligns with indicators 2 and 3's third ESD principle about the learning process. The IPAS learning process in grade IV at these six elementary schools has enabled students to understand the three aspects of ESD and their interrelationships, while also developing critical thinking, problem-solving skills, and positive values and attitudes toward sustainability.

Students are trained to think critically and solve problems, and are introduced to ESD sustainability values and attitudes, such as a sense of responsibility in completing their group performance tasks. Thus, each student is also stimulated to be active in the group. Indicator 1 of the learning process principle, which emphasizes student engagement in IPAS subjects, is also applied in this way. Another example of the application of the third principle of indicators 1 and 2 in IPAS learning in grade IV of elementary school in Moyudan District is presented in Figure 2 below. An example of applying the third principle of indicators 1 and 2 in IPAS learning for grade IV in Moyudan District is presented in Figure 2 below.

Figure 2. The Application of the Principles of Student Involvement and Problem Solving

The application of the third principle of indicators 1 and 2 in IPAS learning involves students actively developing problem-solving skills, as shown in Figure 2, through discussions and group projects on the topic of cultural diversity in Indonesia. The outcome of these discussions and group projects is to present their group projects to other groups using window shopping. Every student will actively visit each other's project stands to learn more and discuss, as well as explain their group project to other groups.

Critical Thinking in IPAS Learning for Grade IV Elementary School

The development of critical thinking skills in IPAS learning for grade IV aligns with the profile of Pancasila students who engage in critical thinking, as outlined in the Merdeka Curriculum. The indicators for critical thinking in the Pancasila student profile differ somewhat from those in the context of ESD. Interviews with six teachers revealed that the IPAS teaching materials used for grade IV students in Moyudan District consist of the revised 2023 edition of the IPAS textbook published by the Ministry of Education and Culture, as well as two student worksheets created and published by local publishers. The student worksheets used in the Moyudan District are the same to ensure standardized learning outcomes for students. The analysis of critical thinking in the ESD context, as developed in the IPAS textbook and student worksheet, is presented in Table 3 below.

Table 3. Critical Thinking in Teaching Materials

| No. | Aspects | Indicator | Textbook | Worksheet | | Average |
				The 1st Semester	The 2nd Semester	
1.	Question norms, practices, and opinions	Expressing ideas and opinions clearly and in a structured manner	23.1%	10,5%	6.25%	13.3%
		Analyze and evaluate information from various sources	23.1%	58%	50%	43.7%
		Making logical conclusions based on existing data and evidence	23.1%	31.5%	43.75%	32.8%
2.	Reflect on values, perceptions, and actions	Identify the problems or challenges faced	23.1%	0%	0%	7.7%
		Comparing and contrasting different arguments or perspectives	0%	0%	0%	0%
		Reflect on one's thoughts and actions, and acknowledge errors or biases	5.7%	0%	0%	1.9%
3.	Take a position in the sustainability discourse	Finding creative and effective solutions to existing problems	1.9%	0%	0%	0.6%

Based on Table 3, the ability to critique existing norms, practices, and views, specifically in relation to Indicator 2, which focuses on analyzing and evaluating information from various sources,

emerged as the most developed critical thinking indicator within the context of ESD. This was particularly evident in the IPAS teaching materials designed for grade IV students in the Moyudan Subdistrict, with an average percentage score of 43.7%. The ability to reflect on values, perceptions, and actions, as outlined in Indicator 2, involves comparing and contrasting various arguments or perspectives with an average percentage of 0%. This critical thinking skill is not developed at all in the teaching materials. However, based on observations, the group discussion method is often used by teachers to develop this indicator in IPAS learning in grade IV elementary school. Therefore, the six teachers explained that students still need guidance in developing critical thinking competencies in learning, even though they already use worksheets.

The critical thinking indicators related to ESD in the IPAS textbook are more thoroughly developed than those found in the two worksheets. In the worksheets, only three aspects of critical thinking in the ESD context are addressed, specifically the ability to critique norms, practices, and viewpoints. However, based on interviews, the two worksheets are more frequently used by teachers and students as teaching materials in grade IV IPAS lessons. This approach streamlines the process for teachers in the Learning Community in the Moyudan District of Sleman Regency, allowing them to create assessments that cover the material scope. An example of the stimulus used in the worksheet to enhance critical thinking skills is illustrated in Figure 3 below.
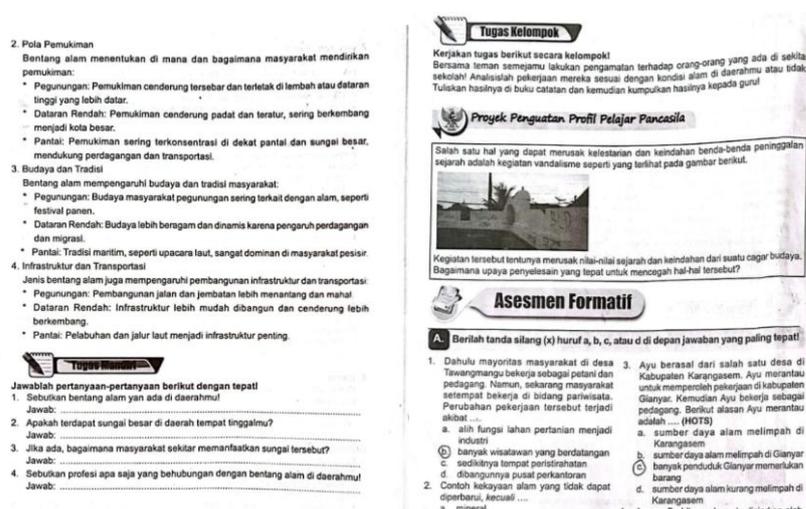

Figure 3. The Stimulus Used in the Student Worksheet to Develop Critical Thinking Indicators

The material summary and list of questions in the independent assignments in each chapter serve as a stimulus in the student worksheet to develop the ability to critique norms, practices, and views in indicators 1 and 2. Group assignments in each chapter serve as a stimulus to develop indicators 2 and 3. As illustrated in Figure 3, students begin by reviewing a summary of the material that explores the relationship between natural landscapes and social conditions in society. Students will first complete an independent assignment on the natural landscapes of their area, applying their understanding from a previous summary of the material. Next, they will work on group assignments that involve observing people around the school and analyzing their work in relation to the natural conditions of their area and other regions. However, the deficiencies in this worksheet do not provide clear guidance on the analysis table or the conclusions column, which may confuse students working on it.

In the ESD context, three aspects of critical thinking are described using seven indicators. However, one indicator remains undeveloped: specifically, indicator 2 in aspect 2, which focuses on the ability to reflect on values, perceptions, and actions. For the remaining six indicators, the IPAS textbook employs a range of stimuli. Indicator 1 in Aspect 1 is stimulated by all "Let's Observe" activities across all chapters, from Chapters I to VIII. All "Let's Investigate" activities in every chapter stimulate Indicator 2 from Aspect 1 and Indicator 1 from Aspect 2. The "Let's Conclude" exercises in each chapter all help to stimulate Indicator 3 in Aspect 1. In Aspect 2, the "Look at Your Surroundings" exercise in Chapters I, II, III, IV, and VII supports Indicator 3. In contrast, the indicator in Aspect 3 is supported by the same activities outlined in Chapters V and VIII. The following Figure 4 illustrates examples of the stimuli used in the science textbook to develop indicators of critical thinking.

Figure 4. The Stimulus Used the Textbook to Develop Critical Thinking Indicators

The "Let's Observe" activity encourages students to develop Indicator 2 in Aspect 1 and Indicator 1 in Aspect 2. In addition to tackling issues and difficulties covered in the IPAS textbook, this entails assessing and analyzing data from multiple sources. Figure 4 highlights pollution and environmental damage as important topics for students to consider. The "Look at My Surroundings" activity encourages students to enhance their skills in indicator 3 of aspect 2. It highlights their ability to reflect on their own ideas and behaviors, while acknowledging any mistakes or biases regarding the sources of environmental contamination in their community and their impact on daily life. The massive management of natural resources in the community without considering their sustainability is an issue raised in the "Look at My Surroundings" activity in chapter V. As a demonstration of sustainability, students are required to use local natural resources to create eco-friendly products. This approach helps students identify innovative and effective solutions for large-scale natural resource management challenges.

Discussion

ESD integration in six elementary schools in Moyudan District remains limited to IPAS learning. It has not yet been extended to the program or to school culture through a whole-school approach. Limited institutional support and minimal teacher training are major factors hindering the implementation of ESD through a whole-school approach (Kadji-Beltran et al., 2017; Fiselier et al., 2018). However, the implementation of a whole-school approach in Japan has significantly influenced teacher practice through leadership support, institutional policies, and guaranteed working conditions that enable teachers to feel safe and take ownership in implementing ESD (Sasaki et al., 2024). Additionally, a comprehensive institutional approach positions schools as microcosms of sustainable development by integrating management, budgeting, curriculum, teacher training, and community relations (Ron et al., 2020).

Utilizing schoolyards as outdoor learning spaces also provides contextual and participatory ESD practices by involving students, teachers, and the school community (El-Aasar et al., 2024; Jeronen et al., 2017; Nordén & Avery, 2020). Outdoor learning can be proven to enrich students' experiences by enhancing ecological understanding, expanding knowledge, and fostering interest and motivation through a fun learning environment (Utari, 2025; Rahayu & Mustadi, 2022). The Adiwiyata program further emphasizes sustainability through 3R waste management, energy and air conservation, and the instilling of environmentally friendly cultural habits (Kartini, 2024). Adiwiyata schools can even foster students' awareness of sustainability, especially in environmental issues, although the social and economic pillars remain suboptimal (Suwarto et al., 2021). However, elementary schools in Moyudan District do not yet have an Adiwiyata leadership institution. ESD integration remains limited to IPAS learning, underscoring the need for a school-wide policy to unify the curriculum, spatial planning, and the overall school culture.

ESD learning materials should incorporate environmental, economic, and social aspects as pillars of ESD (Glavič, 2020), which are closely related to sustainability issues (Siregar et al., 2023). The integration of the three ESD pillars in the grade IV IPAS curriculum in Moyudan District has not been balanced. Two schools emphasized social and economic aspects more than environmental ones. This situation indicates that ESD implementation often sacrifices one of the pillars (Kopnina, 2020). The complexity of sustainability issues consistently leads to contradictions among ESD pillars, making it challenging for teachers to integrate them coherently (Hung & Pan, 2025). Prioritizing policies and curriculum design for one aspect also affects the balance of ESD pillar implementation (Fredriksson et al., 2020; Holst et al., 2020). Furthermore, the responsibility for ESD implementation is often delegated to local actors, resulting in inconsistent and fragmented integration across schools and regions (Charif, 2023; Hung & Pan, 2025).

Students' low ability to holistically connect the three pillars of desire supports the performance of ESD implementation (Li & Li, 2023). Elementary school students in Indonesia have not adequately developed their systems-thinking skills, as indicated by PISA results, and thus continue to struggle to analyze the interconnections among aspects of desire (Suryani & Hamdu, 2025). To address this challenge, the Merdeka Curriculum encourages the integration of local wisdom through a contextual approach (Suprapto et al., 2021; Tyas et al., 2024) that aligns with the concept of ethnoscience (Fatkhiyani & Dewi, 2020). This method has been shown to enhance the relevance of learning for students' real lives while fostering conservation character. The primary aim of its implementation is to enhance students' awareness, skills, understanding, and motivation toward their desires (Windiyani et al., 2025; Timm & Barth, 2020). IPAS materials related to real-world issues such as pollution, climate change, and conservation also strengthen ESD implementation by aligning with the SDGs and by delivering skills development and scientific research (Parker, 2017; Sari et al., 2022). Therefore, this study confirms that efforts to balance the ESD pillars require an adaptive, strategic curriculum and sustained teacher support, both in Indonesia and globally.

Teachers employ project-based approaches, discussions, and window-shopping techniques to enhance student engagement in IPAS learning. This method aligns with the Merdeka Curriculum, which promotes inquiry, problem-solving, and project-based approaches to develop critical thinking skills regarding scientific and social issues (Wulandari et al., 2023). This practice is also consistent with research demonstrating the effectiveness of project-based learning in improving critical thinking skills and student participation (Pangestu et al., 2024; Mustadi et al., 2024). Grade IV IPAS teachers also engage students by providing opportunities to ask questions, discuss, and summarize the material (Suryani et al., 2025). Students' critical thinking skills in elementary schools in Moyudan District remain limited because the student worksheet covers only three indicators, while the science textbook presents a broader range. This situation reinforces findings regarding the dominance of memorization in teaching materials and confirms the gap between the Pancasila student profile and the ESD indicators measured in PISA (Gunawan et al., 2023; OECD, 2018). Therefore, elementary school students often need teachers to develop critical thinking skills in their learning, especially in formulating problems, responding to complex issues, and drawing conclusions (Fitriyadi & Wuryandani, 2021).

The critical thinking indicator most frequently developed in grade IV IPAS teaching materials is the ability to analyze and evaluate information from various sources, with an average percentage of 43.7%. The tool for comparing different arguments or perspectives has not yet been developed. Accordingly, aspects of information analysis and evaluation are easier to measure and are therefore more frequently emphasized in educational practice (Straková & Cimermanová, 2018). Conversely, the absence of development of reflective-contrastive indicators supports the criticism that ESD in many contexts still underemphasizes the critical dimension related to prevailing norms, values, and views (Cebrián et al., 2020; Kioupi & Voulvoulis, 2019). Research shows that teachers often approach the development of this indicator with caution due to various factors, including their personal dispositions, school culture, and limited institutional support. As a result, the teaching materials tend to focus more on analytical skills rather than fostering critical attitudes toward social structures (Hogan & O'flaherty, 2021; Straková & Cimermanová, 2018). However, learning practices in grade IV of Moyudan's Natural Sciences class show that teachers use group discussion methods to develop students' ability to compare perspectives, in line with research confirming the effectiveness of dialogic education in strengthening critical-reflective abilities in the ESD context (Khasanah et al., 2025). This study confirms that while developing critical thinking in ESD focuses heavily on information analysis, greater attention is needed

for value reflection and perspective contrast, which require intentional pedagogical interventions and institutional support to achieve optimal development.

Limited teaching materials are a major factor influencing teachers' challenges in developing students' critical thinking competencies (Rindengan, 2023) and hampering the implementation of ESD in schools (Suárez et al., 2023; Abo-Khalil, 2024). Another challenge comes from the insufficient variety and quality of media that can stimulate critical thinking processes (Sulthon et al., 2021). Only 25% of elementary school teachers in Indonesia can develop critical thinking assessment rubrics based on ESD (Herdianti et al., 2023). The findings of this study strengthen this evidence by providing empirical context that teachers in Moyudan still need intensive guidance to integrate ESD while developing students' critical thinking. Therefore, developing project-based teaching materials relevant to the issue of displacement is a strategic step to improve critical thinking skills and strengthen the implementation of ESD in elementary schools.

Improving the implementation of ESD and enhancing grader IV critical thinking skills in IPAS can be achieved by addressing the key issues identified by UNESCO through project-based and problem-based learning models. Previous research has demonstrated that problem-based learning effectively enhances students' critical thinking skills when applied to biodiversity issues (Shabrina et al., 2024). Furthermore, other relevant sustainability issues include climate change, global justice, sustainable consumption and production, poverty reduction, and disaster risk reduction (UNESCO, 2018a). All of these issues are developed on the basis of the three main pillars of ESD: the interconnected environmental, economic, and social aspects (Mulyadiprana et al., 2024). Teachers can address these issues by taking specific steps, such as providing relevant, contextually appropriate projects, promoting active problem-solving, using project-based learning models, facilitating collaborative learning, and offering constructive feedback to enhance students' critical thinking skills (Nawangsari et al., 2022).

Generally, the incorporation of ESD principles in elementary schools in Moyudan remains incomplete and has not yet affected school programs or culture. Established ESD practices, such as holistic projects (Down & Down, 2018), whole-school approaches (Bosevska & Kriewaldt, 2020; Sasaki et al., 2024), Adiwiyata schools (Kartini, 2024; Suwarto et al., 2021), and programs targeted at bolstering actions during secondary graduation (Olsson et al., 2022). These are contrasted with this assessment. This study offers a new perspective on IPAS teachers' practices in integrating ESD within non-Adiwiyata elementary schools in Indonesia, with a focus on developing students' critical thinking. The practical implications are the need for: (1) strengthening whole-school policies in elementary schools; (2) developing ESD-based student worksheets; and (3) teacher training focused on the integration of ESD and critical thinking. Therefore, this study contributes to the global literature by providing empirical evidence from the Indonesian context and offering directions for the development of more sustainable elementary education policies.

Conclusion

Grade IV teachers in Moyudan Subdistrict have implemented ESD principles in IPAS learning through an interdisciplinary approach, utilizing teaching materials that link economic, environmental, and social aspects to real-world issues and local needs, and engaging in discussion- and project-based learning processes that encourage active student participation. The development of critical thinking in students within the context of ESD is facilitated through classroom activities and innovative projects, utilizing teaching materials that rank highest on the indicator of analyzing and evaluating information, at 43.7%. Meanwhile, the indicator for comparing perspectives and reflecting on values shows a 0% score, indicating it has not been addressed at all. Learning also contributes to strengthening positive values and attitudes towards sustainability. Teachers and schools can certainly optimize ESD integration by adopting a whole-school approach and enhancing all indicators of critical thinking within ESD for students. Additional research implications could explore the simultaneous implementation of ESD across multiple disciplines and schools, as well as the development of creative teaching resources to facilitate a more comprehensive implementation of ESD in elementary schools.

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