



This Bridging Knowledge and Action: Enhancing Critical Thinking through ESD in Economics Subject at Adiwiyata Schools

^aTitik Handayani Bawadi and ^bNofriansyah

Affiliation:

^{a,b} Universitas Pendidikan Indonesia

Contact:

nofriansyah10@upi.edu

DOI:

[10.32424/seej.v7i2.22004](https://doi.org/10.32424/seej.v7i2.22004)

Article History:

Received: 25 July 2025

Revised: 21 Sept 2025

Accepted: 23 Sept 2025

Published: 05 October 2025

Abstract:

This study investigates the integration of sustainable development principles into the high school economics curriculum and its impact on students' understanding of the interconnections between economic activities and sustainability. A mixed-methods approach was employed, combining qualitative methods, including classroom observations, teacher interviews, and student interviews, with quantitative methods using questionnaires to assess students' understanding of Education for Sustainable Development (ESD). These instruments were used to evaluate the effectiveness of ESD implementation by examining students' knowledge, attitudes, and behaviours toward sustainable economic practices. The findings reveal that the integration of ESD into the economics curriculum was successfully implemented and generated positive and significant outcomes in the learning process. Integrating sustainability principles into economics education enhances students' understanding of the relationship between economic activities and sustainability while strengthening their critical thinking and problem-solving skills. These findings provide a practical basis for implementing sustainability-oriented economics learning within the Kurikulum Merdeka, particularly by integrating real-world economic and environmental issues into classroom learning and developing them into contextual Projek Penguatan Profil Pelajar Pancasila (P5) activities.

Keywords: critical thinking, economic subject, education for sustainable development (ESD).

Introduction

The idea of Education for Sustainable Development (ESD) has become increasingly important as societies face interconnected challenges, including resource depletion, socioeconomic inequality, climate change, and unsustainable patterns of production and consumption (UNESCO, 2017a). ESD seeks to equip learners with the knowledge, skills, attitudes, values, and competencies required to contribute to sustainable development (Tilbury, 2011). Within this context, economics education has particular relevance because economic activities are closely connected to environmental and social outcomes through production, consumption, resource allocation, and policy decisions. Nevertheless, the integration of sustainability into

economics education remains uneven, and empirical research examining how sustainable development can be systematically embedded within economics curricula remains relatively limited (Bradley, 2019). This situation indicates the need to move beyond conceptual discussions of ESD toward approaches that demonstrate how sustainability principles can be translated into meaningful classroom practices.

At the secondary school level, the implementation of ESD presents several practical challenges. Empirical research has shown that teachers may experience difficulties in translating sustainability principles into classroom activities because of limited teaching resources, insufficient professional preparation, curriculum overload, time constraints, and limited institutional support (Borgh et al., 2012; Do and Think, 2025). Teachers may also lack concrete examples of how sustainability issues can be incorporated into subject-specific teaching, while established disciplinary traditions can constrain the adoption of more holistic ESD approaches (Borgh et al., 2012). Similarly, research on secondary education indicates that meaningful sustainability learning requires students to engage with real-life problems and develop the capacity to consider multiple perspectives and possible courses of action rather than merely acquire factual knowledge about environmental issues (Kater-Wettstädt, 2018). Recent research further suggests that challenge-based and student-centred approaches can provide opportunities for connecting sustainability issues with disciplinary knowledge, although teachers continue to face challenges related to curriculum flexibility, time, and interdisciplinary collaboration (Schutte et al., 2025). These findings demonstrate that the central issue is not simply whether sustainability is included in the curriculum, but how it is pedagogically connected to students' everyday experiences and disciplinary learning.

This issue is particularly relevant in Indonesian schools implementing environmental education initiatives, including Adiwiyata schools. The Adiwiyata framework provides an institutional context in which environmental awareness and sustainable practices can become part of school life; however, environmental activities at the school level do not automatically ensure that sustainability principles are meaningfully integrated into every subject. Research on Indonesian schools indicates that school environments, policies, social contexts, knowledge, attitudes, and stakeholder engagement can shape students' sustainable behaviour, suggesting that sustainability education requires coherence between school practices and learning experiences (Rahmania, 2024). Consequently, economics classrooms provide an important but underexplored space for connecting environmental concerns with economic reasoning. Issues such as excessive consumption, household waste, responsible production, resource efficiency, green economic activities, and the social consequences of inequality can be transformed into contextual economic problems through which students examine the interdependence between economic decisions and sustainability. Such integration is particularly important because students may otherwise

encounter sustainability primarily as an environmental issue rather than as an integral dimension of economic decision-making.

Against this background, the integration of ESD into senior high school economics education requires a shift from treating sustainability as an additional topic toward embedding it within the teaching and learning of core economic concepts. Previous studies have demonstrated that curriculum-based integration can connect environmental, social, and economic dimensions of sustainability with students' subject learning, but implementation depends strongly on curriculum structure, teacher capacity, pedagogical approaches, and school-level support (Schutte et al., 2025). In the Indonesian context, this direction is also compatible with the orientation of Kurikulum Merdeka, which emphasizes contextual and meaningful learning and provides opportunities for students to engage with real-world issues through project-based activities, including the *Projek Penguatan Profil Pelajar Pancasila* (P5). Therefore, this study examines the integration of sustainable development principles into the senior high school economics curriculum, with particular attention to classroom implementation and students' understanding of the interconnections between economic activities and sustainability. By examining classroom observations, teacher and student perspectives, and students' understanding of ESD, this study seeks to provide empirical evidence on how sustainability principles can be operationalized within economics learning and translated into contextual learning activities in Indonesian senior high schools.

Literature Review

Education for Sustainable Development (ESD) has evolved from the broader environmental education movement into an international educational framework for addressing the interconnected economic, social, and environmental dimensions of sustainable development. Its development can be traced through major international milestones, including the 1972 Stockholm Conference, the 1992 Earth Summit in Rio de Janeiro, and the subsequent development of sustainability-oriented educational agendas (Wals & Kieft, 2010). The adoption of the 2030 Agenda for Sustainable Development further strengthened the position of ESD through Sustainable Development Goal (SDG) 4, Target 4.7, which calls for learners to acquire the knowledge and skills needed to promote sustainable development and sustainable lifestyles (United Nations, 2015). Thus, ESD is not limited to environmental education but represents an educational approach that connects knowledge, skills, values, attitudes, and action across the economic, social, and environmental dimensions of sustainability (Leicht et al., 2018).

This broader orientation is important because sustainable development cannot be adequately addressed through environmental knowledge alone. ESD emphasizes experiential, participatory, and

problem-oriented learning that enables students to examine complex problems, consider alternative perspectives, and translate knowledge into responsible action (Leicht et al., 2018; Oe et al., 2022). In this respect, education becomes a mechanism through which students develop not only cognitive understanding but also the values and competencies required to respond to sustainability challenges (Kusumaningrum et al., 2023). The interdisciplinary character of ESD also means that sustainability principles can be embedded within subject-specific learning, including economics education, rather than being treated as a separate environmental topic (Filho, 2009). This is particularly significant for economics because decisions concerning production, consumption, resource allocation, economic growth, and distribution have direct social and environmental consequences.

Research on ESD in economics education generally supports the value of connecting economic learning with sustainability, although studies differ in their educational settings and emphases. Berglund et al. (2014), for example, demonstrated the potential of ESD-oriented economics education to strengthen students' understanding of sustainability, suggesting that economic concepts can become a meaningful entry point for discussing sustainable development. Similarly, Sierra (2020) found that active learning strategies such as simulations and role-playing can strengthen knowledge acquisition, problem-solving, critical thinking, and interpersonal competencies. These studies share the assumption that sustainability learning becomes more meaningful when students actively engage with economic and social problems rather than simply receive information. However, the literature also identifies implementation constraints. Stössel et al. (2021) highlighted the importance of teacher preparation, time, and instructional resources, while Novo-Corti et al. (2018) noted that the integration of sustainability into economics curricula requires changes not only in curriculum content but also in attitudes and educational practices. Taken together, these studies indicate that the effectiveness of ESD in economics depends not simply on adding sustainability topics to the curriculum, but on teachers' capacity to connect disciplinary economics with authentic sustainability problems through appropriate pedagogical approaches.

The Indonesian literature provides a complementary but somewhat different perspective. Research on ESD implementation in Indonesia has frequently focused on students' environmental awareness, critical thinking, and learning outcomes. Studies by Rahmayanti et al. (2021), Lutfianis et al. (2020), and Maulina et al. (2023), for instance, demonstrate that ESD-oriented and problem-based learning approaches can contribute to students' critical thinking development. The similarity across these studies is their emphasis on active and problem-oriented learning as a means of transforming sustainability concepts into student competencies. Nevertheless, their primary focus is on learning processes and student outcomes rather than on how sustainability principles are specifically integrated

into economics as a disciplinary subject. This distinction is important because economic reasoning introduces questions of trade-offs, incentives, resource allocation, consumption, production, and distribution that cannot be fully represented through a predominantly environmental perspective. Consequently, evidence that ESD improves general critical thinking does not, by itself, explain how students develop an integrated understanding of the relationship between economic activities and sustainability.

The Indonesian context also provides a distinctive institutional setting through the Adiwiyata Programme. Introduced through collaboration between the Ministry of Environment and the Ministry of Education and Culture in 2006, the programme was designed to encourage schools to develop environmentally responsible and environmentally cultured school communities (Desfandi, 2015). The Adiwiyata framework subsequently provided an institutional mechanism for embedding environmental awareness into school policies, practices, and educational activities (Indahri, 2020; Suwanto et al., 2021). Empirical studies indicate that participation in the Adiwiyata programme can contribute to students' environmental knowledge and environmental management awareness (Pali et al., 2021). However, Kodir et al. (2022) argue that the impact of Adiwiyata should not be restricted to students' understanding of the school environment; the surrounding environment can also become a broader learning context. This observation is particularly relevant to economics education because environmental problems outside the school can be transformed into economic learning problems involving consumption, waste, resource use, production, and community welfare.

The existing literature therefore reveals both convergence and a significant contextual gap. International studies generally emphasize the integration of sustainability competencies into disciplinary learning and identify teacher capacity, curriculum structure, and pedagogical resources as important implementation conditions (Berglund et al., 2014; Stössel et al., 2021). Indonesian studies, in contrast, provide substantial evidence concerning environmental awareness, critical thinking, problem-based learning, and the institutional role of Adiwiyata schools (Desfandi, 2015; Pali et al., 2021; Maulina et al., 2023). However, these strands of research have rarely been brought together to examine how ESD is operationalized specifically through economics learning in schools that already have an institutional commitment to environmental sustainability. In other words, an Adiwiyata designation provides a sustainability-oriented school environment, but it does not necessarily demonstrate how sustainability is translated into subject-specific economic reasoning and classroom learning.

This distinction establishes the novel value of examining economics education in Adiwiyata-designated schools. First, economics provides a disciplinary perspective through which students can

understand sustainability not only as environmental responsibility but also as a consequence of economic decision-making. Second, the Adiwiyata setting provides an institutional context in which environmental practices and sustainability values are already embedded in school life, allowing the study to examine whether and how these institutional commitments are translated into classroom-level economics learning. Third, examining both students' cognitive and affective understanding provides a more comprehensive perspective than studies that focus primarily on environmental knowledge or critical thinking outcomes. The combination of these dimensions makes it possible to investigate whether sustainability is functioning as an integrated component of economics education rather than as an additional environmental theme.

Accordingly, this study focuses on the implementation of ESD in high school economics learning within Adiwiyata-designated schools. Rather than asking only whether ESD improves students' learning outcomes, the study examines how sustainable development principles are incorporated into economics learning and how students understand the interconnections between economic activities and sustainability. This focus addresses a gap between the international literature on ESD and economics education and the Indonesian literature on Adiwiyata and ESD-oriented learning. It also provides an empirical basis for understanding how the sustainability-oriented environment of Adiwiyata schools can be translated into contextual economics learning that develops students' knowledge, attitudes, critical thinking, and capacity to consider sustainable economic practices.

Research Methodology

The main purpose of this study is to examine how students' cognitive, affective, and behavioural understanding of Education for Sustainable Development (ESD), as integrated into Economics education, is associated with the development of critical thinking skills in an Adiwiyata school. Based on this purpose, the research questions are formulated as follows:

Q1: How is the integration of Education for Sustainable Development (ESD) principles in Economics education at an Adiwiyata school implemented to support students' critical thinking skills?

Q2: What is the effect of students' cognitive, affective, and behavioural understanding of ESD on their critical thinking skills in an Adiwiyata school?

Q3: What are the challenges and practices in implementing ESD-focused Economics education at an Adiwiyata school, and how do they relate to the development of students' critical thinking skills?

The research employed a mixed-methods approach using a convergent parallel design. Mixed-methods research integrates quantitative and qualitative approaches to provide a comprehensive understanding of a research problem (Ghiara, 2020). Following Creswell (2014), the convergent parallel design involves collecting quantitative and qualitative data concurrently, analysing each dataset separately, and subsequently integrating the findings during the interpretation stage. In this study, the quantitative and qualitative data were collected during the same research period to obtain complementary evidence regarding the implementation and outcomes of ESD in Economics learning.

The quantitative component used a self-reported questionnaire to measure students' cognitive, affective, and behavioural understanding of ESD and their critical thinking skills in the context of Economics learning. The questionnaire was distributed through Google Forms and completed by 102 Grade XII students at SMA Negeri 3 Bandung who had selected Economics as their area of specialisation. Purposive sampling was used because the participants were required to have direct experience with Economics learning in an Adiwiyata school context. Purposive sampling involves selecting participants based on specific characteristics relevant to the research objectives rather than through random selection (Ismail & Irhashih Ilyas, 2023). The quantitative data were analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM) with SmartPLS 3.0. PLS-SEM was used to evaluate the measurement model and examine the structural relationships among the latent variables simultaneously (Kusnendi & Ciptagustia, 2023).

At the same time, qualitative data were collected through semi-structured interviews with Economics teachers and selected students, complemented by classroom observations of Economics learning activities incorporating ESD. The interviews explored teachers' and students' experiences of integrating ESD into Economics learning, the learning strategies used to develop critical thinking, and the challenges encountered during implementation. Classroom observations were conducted to examine how ESD principles and critical-thinking-oriented activities were implemented in actual Economics lessons. Particular attention was given to how teachers integrated sustainability issues into existing Economics content, managed instructional time, and maintained the conceptual depth of Economics learning. The two datasets were initially analysed separately according to their respective methodological procedures. The quantitative analysis identified



Figure 1. Research Framework

The framework of this study is illustrated in Figure 1, which presents the research concept. A hypothesis is a provisional answer to a research question, the truth of which is uncertain and will only be validated when supported by evidence (Ismail & Irhashih Ilyas, 2023). This study includes the hypothesis that understanding ESD will influence Critical Thinking.

Results and Discussions

Q1: How does the integration of Education for Sustainable Development (ESD) principles in Economics education at Adiwiyata School enhance students' critical thinking skills?

To improve critical thinking abilities and sustainability awareness, recent research has investigated the incorporation of Education for Sustainable Development (ESD) principles into the classroom. According to research, including ESD in different teaching strategies can significantly enhance students' critical thinking capacity and understanding of sustainability issues. According to one study, junior high school pupils who took an E-module on environmental degradation with ESD components developed strong critical thinking abilities and a strong awareness of sustainability (Sobari et al., 2022). During the COVID-19 epidemic, another study showed that project-based learning with ESD successfully enhanced students' critical thinking abilities in a variety of areas (Rahmayanti et al., 2021).

SMAN 3 Bandung implements environmental education through various intracurricular, extracurricular, and co-curricular activities. Based on the results of interviews conducted with teachers at the school, it was explained that for Intracurricular Environmental Learning, including material on educational for sustainability (ESD), materials are integrated into subjects that are taught intracurricularly. This allows students to understand environmental concepts in a broader academic context. One of the aspects integrated with the curriculum is learning about biodiversity by utilizing the surrounding environment through the green school program (Gusti et al., 2024).

One of the excellent programs at SMAN 3 Bandung that supports the ESD program is RBL (Research-Based Learning), which has been in place since 2011 and is designed to allow students to express their creative thinking through the stages of the scientific method. The goal is to develop students' critical and analytical thinking skills so that they can systematically apply science literacy. RBL encourages students to explore creative concepts that cross multiple fields. The curriculum focuses not only on

completing learning stages but also on helping pupils expand their creativity and analytical abilities. Based on information from teachers who coach RBL, more than 3000 students have been involved in the program, producing more than 800 papers.

The school offers a variety of extracurricular activities that promote environmental awareness and character education. Religious extracurricular programs like DKM Al Furqan, for instance, help students develop their religious character while also instilling principles like environmental awareness and accountability. One of the extracurricular activities at SMAN 3 Bandung that focuses on ecological issues is ALGA (Three Ecological Activists). Students who are concerned about the environment have the chance to participate in this extracurricular activity by taking practical action. Students interested in environmental issues from SMAN 3 Bandung founded ALGA. Activities carried out by ALGA include Environmental Cleanliness Action, Waste Management, and Environmental Campaigns.

The purpose of SMAN 3 Bandung's co-curricular activities is to enhance intracurricular instruction. Students are urged to apply their knowledge in a real-world setting through environmental issues-related homework assignments, which improves their comprehension and ecological consciousness. One part that cannot be separated from the Curriculum Merdeka at SMAN 3 Bandung is the existence of project-based activities, namely the Pancasila Student Profile Project or what we know as P5. Based on Permendikbud Ristek No 56/M/2022, the Pancasila Learner Profil Strengthening Project (P5) is a project-based co-curricular activity designed to strengthen efforts to achieve competencies and characters following the Pancasila learner profile compiled based on the Graduate Competency Standards. One of the themes in P5 is Sustainable Lifestyle, and this has educated many students to participate in protecting the environment and understand the importance of preserving nature.

ESD Learning Process in Economics Subject

Based on the results of interviews the author conducted with economics teachers, the integration of education for sustainable development is carried out in various learning activities. According to (Kardoyo et al., 2024), teachers, subjects, curriculum development, and the educational system can all benefit from incorporating the idea of ESD. Education will create a generation with attitudes, abilities, and knowledge that support more sustainable conduct. Integrating Education for Sustainable Development (ESD) into economics can be a powerful way to connect theoretical knowledge with real-world challenges. Here are some strategies that economics teachers can use in their classes.

Table 1. Strategy Teacher for ESD in Economics Subject

Dimension	Description	Example in Economics Subject
Cognitive (Knowledge & Understanding)	To develop students' understanding of sustainability issues related to economics, teachers use Problem-Based Learning and project-based learning to teach in Class	Learning about Circular Economy, Economic growth and Development, and Economics Policy
Socio-Emotional	Encouraging ethical decision-making, empathy, and responsibility toward sustainable development	Discussing economic policy, Inflation, and Impact on the Public, Green Economy
Behavioral (Skills and Actions)	Fostering problem-solving, critical thinking, and doing projects like business planning and calculating daily expenses.	Demand and Supply, Consumer Behaviour Theory
Interdisciplinary (Integration with Other Subjects)	Connecting economics with environmental science, social studies, and ethics. There are 2 programs in This School, like P5 (Proyek Penguatan Profil Pelajar Pancasila) and RBL (Research-Based Learning)	Create a project with a sustainable lifestyle theme, using existing and renewable resources related to the economic material such as production and consumption activities.
Participatory (Student Engagement & Collaboration)	Engaging students in active learning discussions	Engaging students with activities and competitions related to the theme of environment and sustainability, such as green economy or economics policy

(Source: Author's interview with Economics Teacher)

In learning economics, teachers use problem-based learning and project-based learning models. This makes students more active in class and dare to express their ideas, especially in analyzing an economic problem given by the teacher. This certainly makes the students' critical thinking skills develop. This is in line with research from (Maxwell et al., 2001), who said that problem-based learning can improve students' thinking skills; students and teachers tackle an issue in the economics PBL lessons that has multiple potential solutions through inquiry, research, and collaborative participation. Students learn that understanding and resolving the issues requires understanding. The following is one of the presentation activities carried out by students when discussing economic growth and development economics.



Figure 2. Discussion Activity on Sustainable Growth and Development in Economic Class

For the Project-Based Learning model, the teacher gives case studies to students in groups to analyze current economic problems and find solutions to overcome these problems by referring to economic policy, both monetary and fiscal policy, that they also learn in class. The result of the discussion will be made in the form of a report that can be read by teachers and their parents as a meaningful learning outcome at school.



Figure 3. Outcomes Project Based Learning

Q2: What is the effect of students' understanding of ESD on students' critical thinking skills in Adiwiyata School?

According to (Purnamasari & Nurawaliyah, 2023) All learning objectives should be guided and met by the development of skills related to sustainable problem-solving and the building of a fair and peaceful future when ESD is implemented. Each of the SDGs has additional specialised learning objectives in addition to sustainability competencies. These particular learning objectives are divided into three categories: behavioral, socio-emotional, and cognitive.

Table 2. ESD Learning Outcome Domain (UNESCO, 2017b)

Domain	Description
Cognitive	This domain consists of the knowledge and thinking skills needed to understand the SDGs
Affective	This domain covers the social skills required in so-operating and collaborating to drive the SDGs, as well as the emotional skills, attitudes, values, and motivation to develop themselves towards sustainability
Behaviour	This domain involves attitudes and actions to take responsibility in sustainable development

According to (Ennis, 1996) Critical thinking is rational, introspective thought that is centered on making decisions about what to believe or do. It requires abilities like logical conclusion-making, argument analysis, evidence evaluation, and objective consideration of another viewpoint. According to Enis, critical thinking should be precise, pertinent, rational, fair-minded, and straightforward, enabling people to make well-informed decisions supported by reliable data. To determine students' understanding of ESD, the questions asked to students include cognitive, affective, and behavioural knowledge. The results of the questionnaire were processed using Smart PLS.

The operational definition of latent variables according to the manifest variables is referred to as the measurement model, as outlined in the outer model and measurement model. The factor weight coefficient (outer loading) is used as a valid indicator to measure latent variables at the indicator level, with the criterion that the factor weight of each indicator must be significant ($p < 0.05$) and the outer moder < 0.70 (Kusnendi & Ciptagustia, 2023). Based on the hypothesis, each question item from X1 and Y meets the requirements, as the outer loading values for each item fulfill convergent validity with an outer loading value of $0.000 > 0.70$.

Table 3. Outer Loading

	Critical Thinking	ESD
AC1	0,886	
AC2	0,864	
AC3	0,866	
AF1		0,807
AF2		0,844
AF3		0,812
BS1	0,885	
BS2	0,802	
BS3	0,841	
BV1		0,791
BV2		0,784
BV3		0,705
EC1	0,862	
EC2	0,876	
EC3	0,877	
INF1	0,910	
INF2	0,919	
INF3	0,812	
KG1		0,761
KG2		0,794
KG3		0,819
ST1	0,889	
ST2	0,856	
ST3	0,880	

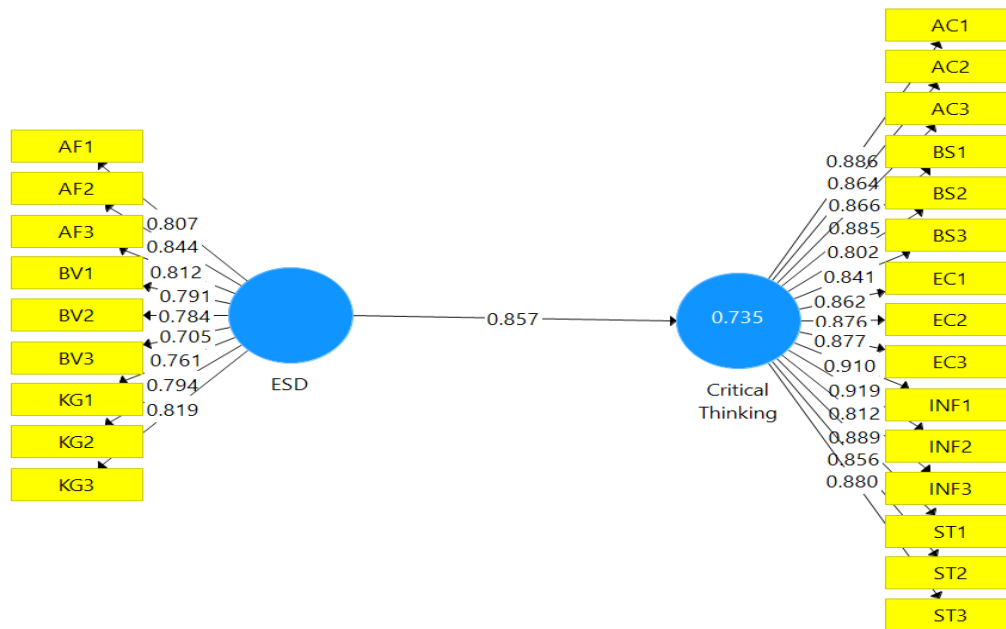


Figure 4. Model Path Coefficients Processed by SmartPLS, 2024

Based on Figure 2, can be concluded that there are 9 questions for X1 (Understanding ESD), namely KG1, KG2, KG3, AF1, AF2, AF3, BV1, BV2, and BV3. Then, there are 15 questions for item Y (Critical Thinking), namely, AC1, AC2, AC3, BS1, BS2, B3, EC1, EC2, EC3, INF1, INF2, INF3, ST1, ST2, and ST3. Therefore, this study includes a total of 24 questions to explain items X1 and Y.

Table 4. Construct Reliability and Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Critical Thinking	0,977	0,977	0,979	0,755
ESD	0,925	0,927	0,938	0,627

The measurement model is considered reliable for measuring the latent variables if the values of $C\alpha$ and CR are both not less than 0.60 or 0.70 and $(C\alpha \text{ and } CR) < 0.90$ (Kusnendi & Ciptagustia, 2023). This means that convergent reliability is accepted or meets the requirements when the $C\alpha$ value is more significant than 0.70. Based on Table 3, it can be seen that the $C\alpha$ value for item X1 is $0.925 > 0.70$, and

the value for item Y is $0.977 > 0.70$. From the values of items X1 and Y, it can be concluded that the values for convergent validity have met the requirements since each item is above 0.70.

Convergent validity refers to the extent to which a formative measurement model positively correlates with another measurement model of the same construct but uses different indicators (Kusnendi & Ciptagustia, 2023). Overall, or at the construct level, convergent validity is evaluated through the AVE statistic. If the AVE value is greater than 0.50, convergent validity is considered accepted or meets the requirements (Kusnendi & Ciptagustia, 2023). Based on Table 3, it can be seen that the AVE value for item X1 is $0.627 > 0.50$ and for Y is $0.755 > 0.50$. Therefore, it can be concluded that the AVE values for items X1 and Y meet the requirements since each item is above 0.50, making them acceptable and retainable.

Table 5. R Square

	R Square	R Square Adjusted
Critical Thinking	0,735	0,732

PLS-SEM aims to maximize the R^2 value for each path model tested, with R^2 values ranging from 0 to 1. The higher the R^2 value, the greater the model's ability to explain the variation in the endogenous construct (Kusnendi & Ciptagustia, 2023). Table 4 indicates that the R-Square value in path model 1 is 0.735, meaning that the variable Understanding ESD influences the variable Critical Thinking by 73.5%, while other variables not included in this study influence the remaining 26,5 %. An R-square value of 73,5% can be categorized as having a big impact since it falls within the range of $R^2 \geq 0,7$.

Table 6. Path Coefficients Bootstrapping

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
ESD -> Critical Thinking	0,857	0,855	0,037	23,278	0,000

Source: Processed by researchers, 2024

The basis for hypothesis testing refers to the path coefficient values, t-statistic values, and p-values. If the t-statistic value is > 1.96 and the p-value is < 0.05 , it can be concluded that the hypothesis is accepted. Based on Table 5, the following results were obtained. Understanding ESD has a positive effect on Critical thinking ($0,000 < 0,05$).

This study demonstrates that students typically possess more critical thinking abilities when they have a deeper comprehension of ESD. This demonstrates that adding an emphasis on ESD to education not only broadens students' perspectives on sustainability skills necessary to tackle problems in the real

world. Thus, including ESD in the curriculum is not merely a choice; rather, it is a practical approach that will help mold a generation that is more critical, ecologically aware, and prepared to support sustainable development.

Q3: What are the challenges and best practices in implementing ESD-focused economics education at Adiwiyata schools, and how do they impact the development of students' critical thinking abilities?

To strengthen students' critical thinking skills through ESD in economics education, schools need a coherent approach that integrates sustainability principles into curricular, co-curricular, and extracurricular activities without displacing the core competencies of the Economics curriculum. The findings of this study indicate that one of the practical challenges in implementing ESD at SMAN 3 Bandung was limited instructional time. Rather than treating ESD as an additional topic requiring separate teaching sessions, teachers addressed this constraint by embedding sustainability issues within existing Economics topics. For example, issues of ethical consumption, resource allocation, sustainable production, environmental entrepreneurship, and renewable energy investment were connected to relevant economic concepts already included in the curriculum. This approach allowed sustainability-related discussions to function as contextual applications of Economics concepts rather than as additional content outside the prescribed curriculum.

Teachers also used focused case studies, problem-based discussions, and short analytical activities to integrate ESD within regular Economics lessons. Instead of allocating extended periods to separate sustainability projects, sustainability-related cases were used as entry points for explaining or applying economic concepts, enabling students to analyse real-world problems while maintaining the intended conceptual progression of the subject. Project-based activities were similarly directed toward existing Economics competencies so that students could apply concepts such as production, consumption, opportunity costs, resource allocation, and entrepreneurship to sustainability-related problems. This strategy helped address the tension between curriculum coverage and conceptual depth: students were not required to learn sustainability as an additional body of knowledge, but were encouraged to use economic concepts to analyse sustainability problems. In this sense, the practical integration of ESD depends less on increasing instructional time than on designing learning activities in which sustainability and Economics content are addressed simultaneously.

The findings further suggest that conceptual depth should be maintained when introducing sustainability issues into Economics learning. Teachers therefore need to distinguish between introducing a sustainability issue merely as a contextual example and using the issue as an analytical economic

problem. The latter requires students to identify economic concepts, examine cause-and-effect relationships, compare alternatives, consider trade-offs, and formulate reasoned solutions. Consequently, activities such as case-study analysis, classroom debates, and structured discussions can be designed around specific Economics learning objectives rather than conducted as stand-alone environmental activities. This approach enables critical thinking to develop through the substantive study of Economics while sustainability provides the real-world context in which those concepts are applied.

Nevertheless, this study has an important limitation concerning its research scope. The study was conducted within a single senior high school, SMAN 3 Bandung, which operates within the Adiwiyata context. Therefore, the findings should be interpreted in relation to this specific institutional and environmental setting and should not be generalized to all Indonesian senior high schools without further evidence. The Adiwiyata context may provide particular institutional practices, environmental programmes, and school cultures that influence the implementation of ESD in Economics learning. Future research should therefore examine multiple schools with different institutional characteristics and, in particular, include non-Adiwiyata schools as a comparative group. Such a comparative design would enable researchers to examine whether differences in students' critical thinking, ESD understanding, and sustainability-oriented learning are associated with the Adiwiyata context or with other school-level, teacher-level, or pedagogical factors. This would provide stronger empirical evidence regarding the contextual contribution of Adiwiyata schools to the implementation of ESD in Economics education.

Conclusion

To strengthen students' critical thinking skills through ESD in economics education, schools need a coherent and holistic approach that integrates sustainability principles across curricular, co-curricular, and extracurricular activities. Within economics learning, teachers can employ student-centred pedagogical approaches, such as problem-based learning and project-based learning, to engage students with authentic sustainability-related economic problems. Activities such as case-study analysis, classroom debates, and discussions on ethical consumption, renewable energy investment, resource allocation, and sustainable production can encourage students to examine multiple perspectives and develop critical reasoning. Similarly, hands-on activities, including environmental entrepreneurship projects and collaboration with environmental institutions, can provide opportunities for students to connect economic concepts with real-world sustainability challenges. These approaches can strengthen students' understanding of the relationship between economic decisions and sustainable development while fostering greater awareness of responsible economic practices.

Nevertheless, this study has an important limitation concerning its research scope. The study was conducted within a single senior high school, SMAN 3 Bandung, which operates within the Adiwiyata context. Therefore, the findings should be interpreted in relation to this specific institutional and environmental setting and should not be generalized to all Indonesian senior high schools without further evidence. The Adiwiyata context may provide particular institutional practices, environmental programmes, and school cultures that influence the implementation of ESD in economics learning. Future research should therefore examine multiple schools with different institutional characteristics and, in particular, include non-Adiwiyata schools as a comparative group. Such a comparative design would enable researchers to examine whether differences in students' critical thinking, ESD understanding, and sustainability-oriented learning are associated with the Adiwiyata context or with other school-level, teacher-level, or pedagogical factors. This would provide stronger empirical evidence regarding the contextual contribution of Adiwiyata schools to the implementation of ESD in economics education.

References

Journal Article

- Berglund, T., Gericke, N., & Chang Rundgren, S. N. (2014). The implementation of education for sustainable development in Sweden: investigating the sustainability consciousness among upper secondary students. *Research in Science and Technological Education*, 32(3), 318–339. <https://doi.org/10.1080/02635143.2014.944493>
- Borg, C., Gericke, N., Höglund, H. O., & Bergman, E. (2012). The barriers encountered by teachers implementing education for sustainable development: Discipline bound differences and teaching traditions. *Research in Science & Technological Education*, 30(2), 185–207. <https://doi.org/10.1080/02635143.2012.699891>
- Bradley, P. (2019). Integrating sustainable development into economics curriculum: A case study analysis and sector wide survey of barriers. *Journal of Cleaner Production*, 209, 333–352. <https://doi.org/10.1016/j.jclepro.2018.10.184>
- Do, N. T., & Thinh, M. P. (2025). Integrating sustainable development goals into high school curricula: Teachers' perceptions and challenges in the Mekong Delta, Vietnam. *International Research in Geographical and Environmental Education*, 1–17. <https://doi.org/10.1080/10382046.2025.2485917>
- Desfandi, M. (2015). Mewujudkan masyarakat berkarakter peduli lingkungan melalui program adiwiyata. *SOSIO DIDAKTIKA: Social Science Education Journal*, 2(1), 31–37. <https://doi.org/10.15408/sd.v2i1.1661>
- Ekamilasari, E., & , Anna Permanasari, I. D. P. (2021). Critical thinking skills and sustainability awareness for the implementation of education for sustainable development. *Journal of Science Education Research Journal*, 2021(1), 46–53.
- Ghiara, V. (2020). Disambiguating the Role of Paradigms in Mixed Methods Research. *Journal of Mixed Methods Research*, 14(1), 11–25. <https://doi.org/10.1177/1558689818819928>
- Gusti, U. A., Hidayat, T., Sriyati, S., & Artikel, R. (2024). *Profil Pembelajaran Keanekaragaman Hayati di Sman 3 Bandung Profile of Biodiversity Learning At Sman 3 Bandung Informasi Artikel Abstract*. 03(01), 47–65.

- Indahri, Y. (2020). Pengembangan Pendidikan Lingkungan Hidup melalui Program Adiwiyata (Studi di Kota Surabaya). *Aspirasi: Jurnal Masalah-Masalah Sosial*, 11(2), 121–134. <https://doi.org/10.46807/aspirasi.v11i2.1742>
- Kardoyo, Setiaji, K., Nurkhin, A., Nasikh, Murniawaty, I., Sakitri, W., & Tusyanah. (2024). Integrating Sustainability into Economics Teacher Education. *Proceedings of the International Conference of Economics Business and Economics Education Science (ICE-BEES-24)*, January. https://doi.org/10.2991/978-94-6463-522-5_31
- Kater-Wettstädt, L. (2018). How secondary-school students deal with issues of sustainable development in class. *Environmental Education Research*, 24(11), 1565-1580. <https://doi.org/10.1080/13504622.2017.1373068>
- Kodir, A., Syaifulloh, M., Indari Monassa, I., Sumarmi, S., & Zubaidah, S. (2022). Environmental Education at Adiwiyata Schools and the Conservation of the Brantas Watershed in Indonesia. *KnE Social Sciences*, 2022, 301–306. <https://doi.org/10.18502/kss.v7i16.12175>
- Kusumaningrum, M. E., Kuswanto, H., Jumadi, Suyanto, S., Suhartini, Purwasih, D., & Prabawati, R. (2023). A Bibliometric Review of Research on Education for Sustainable Development, 2019-2023. *International Electronic Journal of Elementary Education*, 16(1), 75–88. <https://doi.org/10.26822/iejee.2023.315>
- Leicht, A., Julia, H., & Byun, W. J. (2018). *Issues and trends in education for sustainable development*. UNESCO PUBLISHING. <https://doi.org/https://doi.org/10.54675/YELO2332>
- Lutfianis, J. A., Chandra Wijaya, A. F., & Purwanto, P. (2020). Application Of Problem Based Learning Model Using Education For Sustainable Development Context In Improving Critical Thingking Ability For Junior High School Students At Heat Theory. *Dinamika Jurnal Ilmiah Pendidikan Dasar*, 12(2), 98. <https://doi.org/10.30595/dinamika.v12i2.6354>
- Maulina, D., Hikmawati, A., & Marpaung, R. R. T. (2023). The Effect of Implementing ESD in the PBL Model on Critical Thinking Ability in Environmental Pollution Material. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, 8(2), 253. <https://doi.org/10.24042/tadris.v8i2.18444>
- Maxwell, N. L., Bellisimo, Y., & Mergendoller, J. (2001). Problem-Based Learning: Modifying the Medical School Model for Teaching High School Economics. *The Social Studies*, 92(2), 73–78. <https://doi.org/10.1080/00377990109603981>
- Novo-Corti, I., Badea, L., Tirca, D. M., & Aceleanu, M. I. (2018). A pilot study on education for sustainable development in the Romanian economic higher education. *International Journal of Sustainability in Higher Education*, 19(4), 817–838. <https://doi.org/10.1108/IJSHE-05-2017-0057>
- Oe, H., Yamaoka, Y., & Ochiai, H. (2022). A Qualitative Assessment of Community Learning Initiatives for Environmental Awareness and Behaviour Change: Applying UNESCO Education for Sustainable Development(ESD) Framework. *International Journal of Environmental Research and Public Health*, 19(6). <https://doi.org/10.3390/ijerph19063528>
- Pali, O., A. Rauf, B., & Amir, F. (2021). Dampak Penerapan Program Adiwiyata Terhadap Peningkatan Pengetahuan Siswa Dalam Pengetahuan Lingkungan Hidup. *UNM Environmental Journals*, 4(1), 01. <https://doi.org/10.26858/uej.v4i1.20343>
- Prayogo, W., Ratnaningsih, W., Suhardono, S., & Suryawan, I. W. K. (2024). Environmental Education Practices in Indonesia: A Review. *Journal of Sustainable Infrastructure*, 3(1), 27–37. <https://doi.org/10.61078/jsi.v3i1.27>
- Purnamasari, S., & Nurawaliyah, S. (2023). Studi Literatur: Penilaian Kompetensi Keberlanjutan dan Hasil Belajar Education for Sustainable Development (ESD). *Jurnal Pendidikan UNIGA*, 17(1), 686. <https://doi.org/10.52434/jpu.v17i1.2553>
- Rahmania, T. (2024). Exploring school environmental psychology in children and adolescents: The influence of environmental and psychosocial factors on sustainable behavior in Indonesia. *Heliyon*, 10(18).

This Bridging Knowledge and Action: Enhancing Critical Thinking through ESD in Economics Subject at Adiwiyata Schools

- Rahmayanti, E., Hendayana, S., & Riandi, R. (2021). Project Based Learning in Pandemic Covid-19: The Implementation of ESD to Develop Students' Critical Thinking Skills. *Unnes Science Education Journal*, 10(3), 137–144. <https://doi.org/10.15294/usej.v10i3.46738>
- Salsabila, E. R., Wijaya, A. F. C., & Winarno, N. (2019). Improving Students' Sustainability Awareness through Argument-driven Inquiry. *Journal of Science Learning*, 2(2), 58. <https://doi.org/10.17509/jsl.v2i2.13104>
- Satrianawati, S., & Fu, W. H. (2019). Education for Sustainable Development (ESD) in Indonesia: A Conceptual Framework. *International Journal of Education and Learning*, 1(1), 42–49. <https://doi.org/10.31763/ijele.v1i1.33>
- Schutte, B. G., Bayram, D., Vennix, J., & van der Veen, J. (2025). Exploring the implementation of challenge-based learning for sustainability education in Dutch secondary education: teachers' experiences. *Environmental Education Research*, 31(6), 1166–1192. <https://doi.org/10.1080/13504622.2025.2458723>
- Sierra, J. (2020). The potential of simulations for developing multiple learning outcomes: The student perspective. *International Journal of Management Education*, 18(1), 100361. <https://doi.org/10.1016/j.ijme.2019.100361>
- Sobari, E. F. D., Hernani, H., & Ramalis, T. R. (2022). Critical Thinking Skills and Sustainability Conciousness of Students for The Implementation Education for Sustainable Development. *Journal of Science Education Research*, 6(2), 75–80. <https://doi.org/10.21831/jser.v6i2.52347>
- Stössel, J., Baumann, R., & Wegner, E. (2021). Predictors of student teachers' esd implementation intention and their implications for improving teacher education. *Sustainability (Switzerland)*, 13(16). <https://doi.org/10.3390/su13169027>
- Suwarto, R. S., Sanjaya, Y., & Solihat, R. (2021). Implementation of education for sustainable development and pupils' sustainability consciousness in Adiwiyata School and ESD-based school. *Journal of Physics: Conference Series*, 1806(1). <https://doi.org/10.1088/1742-6596/1806/1/012153>
- UNESCO. (2017a). Education for Sustainable Development Goals: learning objectives. In *Education for Sustainable Development Goals: learning objectives* (Issue March). <https://doi.org/10.54675/cgba9153>
- UNESCO. (2017b). Education for Sustainable Development Goals: learning objectives. In *Education for Sustainable Development Goals: learning objectives* (Issue March). <https://doi.org/10.54675/cgba9153>

Book

- Creswell, J. W. (2014). *Research Design* (IV). SAGE Publications Inc.
- Ennis, R. H. (1996). *Critical Thinking* (Illustrated). Prentice Hall, 1996.
- Filho, W. L. (2009). Toward The Promotion of Education for Sustainability. *Revista de Educacion, SPEC. ISSUE*, 263–277.
- Ismail, M. I., & Irvashih Ilyas, N. (2023). *Metodelogi Penelitian Kualitatif dan Kuantitatif*. Rajawali Press, Jakarta
- Kusnendi, C. and A. (2023). *Analisis Model Pengukuran dan Struktural Dalam Penelitian Manajemen Dan Bisnis*. UPI Press.
- Nation, U. (2015). "Transforming our world: the 2030 Agenda for sustainable development." A/RES/70/1.
- Tilbury, D. (2011). Education for sustainable development: An expert review of processes and learning. *Unesco*, May, 132.
- Wals, A. E. J., & Kieft, G. (n.d.). *Sida Review 2010:13 Education for Sustainable Development Research Overview*.