

ESD Integration in Prospective Science Teachers: An Analysis of Pro-Environmental and Climate Issues

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Abstract

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Education for Sustainable Development (ESD) is an educational approach designed to equip students with knowledge, skills, and values that support sustainable development. ESD emphasizes the principle of “Think globally, act locally” to encourage concrete actions in addressing global challenges such as climate change. This study aims to analyze the level of knowledge, attitudes, and pro-environmental behaviors of prospective science teachers regarding climate change issues. The research employed a descriptive qualitative method with data collected through literature studies, interviews, and document analysis. The findings indicate that prospective science teachers possess a basic understanding of environmental and climate change issues. However, there remains a noticeable gap between cognitive knowledge and actual practices in daily life. These results highlight the importance of strengthening the integration of ESD into the teacher education curriculum, both through pre-service and in-service training. Such efforts are essential to develop change agents capable of embedding sustainability values into science education and fostering a more environmentally responsible generation.

1. Introduction

The era of disruption has brought about major changes in almost all aspects of human life, including the education system. The wave of digital transformation, globalization, and rapid technological development requires the world of education to adapt dynamically. The education system is no longer enough just to transmit knowledge but must also equip students with 21st-century skills that emphasize critical thinking, creativity, collaboration, and communication. This is in line with the demands of an increasingly complex, competitive, and innovation-oriented global workforce and society. Education in the era of disruption is required to be flexible, relevant, and capable of preparing the younger generation to face unexpected changes.

The shift in the learning paradigm from a traditional model to digital learning is one of the main characteristics of this era. Conventional teacher-centered methods are no longer sufficient. Digital technology opens up opportunities to create a more interactive, personal, and collaborative learning model through the use of online platforms, educational applications, and multimedia-based approaches (Al Muwali et al., 2019). However, this transformation also presents significant challenges. Inequality of access to digital devices and the internet creates an education gap, especially in developing countries like Indonesia. In addition, the readiness of teachers to utilize technology is still a serious problem. Many educators do not yet have adequate digital skills, so the application of technology is not optimal. Another no less important challenge is curriculum relevance. The Indonesian education

curriculum still focuses on the cognitive aspects and has not fully emphasized the adaptive skills needed in the era of disruption.

In fact, rapid social and economic changes demand a more flexible, contextual, and competency-based curriculum. This condition is exacerbated by the potential negative impacts of technology, including psychological pressure and the mental well-being of students and teachers due to drastic changes in learning patterns. In addition to technological aspects, the era of disruption also poses a threat to the nation's cultural values and ideology. Radicalism, intolerance, and terrorism are increasingly easy to spread through digital media. This requires education to not only focus on 21st-century skills but also on strengthening character and instilling national values. Pancasila, as the state foundation of Indonesia, has universal values that can counteract radical and intolerant ideologies (Subaidi, 2020). Therefore, strengthening Pancasila values education at all levels of education is an important strategy in maintaining the integrity of the nation while forming a young generation that is a person of integrity, tolerant, and has a national perspective.

In this context, the concept of Education for Sustainable Development (ESD) becomes relevant. ESD emphasizes the integration of knowledge acquisition, skill development, and the formation of values and attitudes. With this approach, students are expected to be able to become critical and adaptive agents of change, as well as contribute positively to the sustainability of society and the environment. The integration of ESD into educational strategies in the era of disruption not only equips students with digital skills but also instills social responsibility, environmental awareness, and national values (Gul & Khilji, 2021). A number of previous studies

have shown the importance of the role of technology, family-school-community collaboration, and the strengthening of values education in facing the era of disruption. These studies emphasize the importance of curriculum innovation, strengthening the role of educators, and utilizing digital technology to create more effective learning.

However, most are still general in nature and have not provided detailed implementative strategies. Not many studies have specifically highlighted the integration of technology, character education, and Pancasila values in the context of Indonesian education in the era of disruption. Its main focus is on optimizing the use of digital technology, developing innovative competency-based curricula, strengthening cross-institutional collaboration, and systematically instilling Pancasila values. With a literature review approach, this paper not only summarizes previous ideas and research but also provides a conceptual synthesis that can be a basis for the development of educational policies and practices in Indonesia.

2. Literature Review

2.1. Digital Technology and 21st Century Education

Digital technology has become a major catalyst in the 21st-century educational transformation process, which is characterized by a shift in the learning paradigm from a conventional system to a more modern, adaptive, and technology-based model (Liesa-Orús et al., 2020). Previous research confirmed that technology today not only functions as a tool in learning activities but also becomes a dominant factor that is truly capable of changing the perspective, methods, and even the

direction of educational policies. The presence of various technological innovations, such as online learning platforms, adaptive learning applications, and the use of interactive multimedia, has enabled the personalization of education that was previously very difficult to achieve through uniform traditional methods. With the support of technology, the learning process can be tailored to the needs, interests, and abilities of each student, thereby creating a more meaningful learning experience (González-Salamanca et al., 2020). In addition, the use of digital technology can also increase active student participation, expand access to learning to previously marginalized areas, and encourage wider and faster cross-geographic collaboration.

However, various studies have also revealed serious challenges that need to be considered, including digital access inequality between regions, the limited technological literacy experienced by most teachers, and the risk of distraction that disrupts students' focus on learning (Kaarakainen & Saikkonen, 2021). Another negative impact that often arises is a decrease in mental health due to excessive technology exposure. Therefore, the majority of academic literature agrees that educational strategies in the era of disruption should emphasize the effective, inclusive, proportional, and balanced use of digital technology so that the benefits produced can be more optimal.

2.2. Character Education, Pancasila Values, and ESD

In addition to technological aspects, previous research has also deeply highlighted the importance of character education as a strong moral fortress in the midst of the strong current of change in the era of disruption. Social phenomena that have emerged, such as radicalism, intolerance, and an identity crisis in the

younger generation, have further strengthened the urgency to present an educational strategy that not only focuses on cognitive aspects but also emphasizes the integration of Pancasila values into all dimensions of education. The national values contained in Pancasila are seen as very strategic because they can maintain social harmony, build a tolerant attitude, and at the same time strengthen the nation's competitiveness in the midst of increasingly fierce global competition (Abdullah, 2017).

In line with this, the concept of Education for Sustainable Development (ESD) is also considered very relevant. ESD emphasizes the balance between academic skills, environmental awareness, and social responsibility, so that it is able to equip students with the ability to adapt and contribute positively to society. Several studies show that the integration of ESD in the curriculum has been proven to produce a younger generation that is critical in thinking, adaptive to change, creative in finding solutions, and has a strong orientation towards sustainability (Hsu et al. 2017). However, the literature also indicates a major challenge, especially related to the weak implementation of character education and ESD in the field. The obstacle that often arises is the still minimal practical strategy for integrating these two aspects with digital technology which has now become the main basis of learning. This condition shows the need for conceptual and implementative breakthroughs so that character education and ESD can truly run effectively in the era of disruption.

3. Methods

This article uses the literature review method as the main research approach. The choice of this method is not without reason, because the literature review is considered to provide a wide space to review, analyze, and synthesize various research results and scientific publications that are relevant to the theme of sustainable education in the era of disruption. Through this approach, researchers not only display a collection of previous findings but also arrange them into a more complete, systematic, and comprehensive conceptual framework. Thus, this article serves to identify trends, find research gaps, and present alternative conceptual strategies that can be applied in the context of Indonesian education.

The literature sources used in this study are very diverse, including national and international journal articles, relevant academic books, and research reports from educational institutions and credible global organizations. The literature that is prioritized is publications in the last ten years, so that the information studied remains up-to-date and relevant to contemporary educational conditions. The main focus of the literature search is directed at central themes, namely the transformation of education in the digital era, the use of digital technology in learning, character education, strengthening of Pancasila values, and the concept of Education for Sustainable Development (ESD). The selection of literature was carried out by purposive sampling by considering the level of relevance to the topic, the credibility of the author or institution, and its contribution in enriching the study's perspective.

Data analysis was carried out through several stages, namely identifying the main themes from the literature, grouping these themes into certain categories, then

synthesizing to form a holistic conceptual framework. Important themes that were successfully identified include the role of digital technology in learning, the challenges of implementing character education, the urgency of strengthening Pancasila values amid the threat of radicalism, and the relevance of integrating ESD in the curriculum. The synthesis is carried out narratively, with an emphasis on the linkage and relationship between aspects of technology, curriculum, character education, and sustainable education.

By using the literature review method, this article seeks to not only repeat the findings of previous studies but also present a new, more integrative perspective on the needs of Indonesian education in the face of the era of disruption. The limitations of this method certainly still exist, namely the dependence on secondary data and the absence of empirical field data. Therefore, further empirical research is still needed to test and validate the effectiveness of the educational strategies offered in this conceptual framework.

4. Results and Discussion

Education in the era of disruption faces great challenges while opening up broad opportunities for comprehensive transformation (Herman, 2021). From the results of the literature review, it can be understood that sustainable educational strategies in the midst of the wave of disruption cannot only emphasize one aspect but must be holistic by including the optimization of digital technology, the development of innovative curricula, the strengthening of character education, the instilling of Pancasila values, the increase in educator capacity, and multi-party

collaboration. The following discussion summarizes the literature findings while providing a conceptual synthesis to clarify the direction of sustainable education that is relevant to the Indonesian context.

The use of digital technology is a fundamental element in education in the era of disruption. Technology provides wide access to learning resources, enables the personalization of learning, and encourages cross-geographic collaboration. Various literatures assert that online learning platforms, educational applications, and interactive multimedia are able to increase student engagement, expand access to education, and present a more creative learning model (Syawaluddin et al., 2020). However, the challenge of access inequality is still very real. Not all students have adequate digital devices or stable internet access, especially in rural areas. This condition has the potential to widen the education gap between regions. Therefore, sustainable educational strategies must include affirmative policies in the form of providing equitable digital infrastructure, device subsidies, and strengthening digital literacy for both students and teachers.

Digital transformation demands the readiness of educators. Teachers are not only learning facilitators but also agents of change who play an important role in assisting students to face the complexity of the era of disruption (Tillmanns, 2020). The digital literacy of teachers is key to ensuring that the use of technology runs effectively. But in reality, many teachers are still not familiar with the use of educational technology. Some teachers find it difficult to integrate digital devices with learning methods that suit student needs. In the literature, it was found that technical training alone is not enough; teachers need capacity building that includes

digital pedagogical aspects, online class management, and the ability to design technology-based curricula. Thus, strengthening teacher competence through sustainable training programs, digital certification, and teacher learning communities is an important strategy.

Curriculum relevance in the era of disruption is a major highlight. A rigid curriculum that focuses on knowledge transfer is no longer sufficient. Global challenges demand a more contextual, competency-based, and adaptive curriculum to change. The 4C literacy critical thinking, creativity, collaboration, communication must be integrated systematically. The curriculum also needs to contain content about digital literacy, entrepreneurship, and environmental awareness as part of the Education for Sustainable Development (ESD) framework (Grosseck et al., 2019). The literature review shows that a competency-based curriculum allows students to develop skills that are relevant to the needs of the 21st century, not just academic memorization. However, its implementation in Indonesia still faces obstacles in the form of limited resources, disparities between schools, and resistance to change. Therefore, the curriculum development strategy must be participatory, involving teachers, practitioners, and stakeholders so that the results are more in line with local and global contexts.

Character education is an important foundation in the midst of the strong current of globalization and digital disruption. Academic literacy without strong character risks producing a generation that is intellectually smart but morally fragile. Radicalism, intolerance, and the spread of extremist ideologies through digital media are real threats that can damage the integrity of the nation. Pancasila as the

foundation of the state contains universal values that can counteract these ideologies. The literature review shows that Pancasila-based education has strategic potential in forming a young generation that is tolerant, fair, and a person of integrity. However, the implementation of Pancasila education is often just a formality in the classroom without internalizing the values in real life. Therefore, sustainable educational strategies must emphasize the integration of Pancasila values into all educational activities, both through the curriculum, extracurricular activities, and school culture. Pancasila-based character education should not stop at the cognitive level but must involve habituation, role models, and real practice in daily life.

The concept of Education for Sustainable Development (ESD) provides a relevant conceptual framework in answering the challenges of the era of disruption. ESD emphasizes the importance of a balance between the dimensions of knowledge, skills, values, and attitudes. With ESD, students are equipped with the ability to become adaptive, critical, and sustainability-oriented agents of change for social, economic, and environmental aspects (Lohmann et al., 2021). In the literature, it was found that ESD is effective in increasing students' awareness of environmental issues, encouraging social responsibility, and building a culture of collaboration. However, the main obstacle to the implementation of ESD is the lack of integration with the formal curriculum and the minimal readiness of educators to teach it contextually. Therefore, sustainable educational strategies in Indonesia need to integrate ESD into cross-subject learning, not just limited to science or environmental lessons (Mironenko & Mironenko, 2020).

Multi-party collaboration is a prerequisite for building sustainable education. Schools cannot work alone without the support of families and communities. The literature asserts that family involvement in children's education plays a large role in strengthening character. Likewise, communities and social institutions can be partners in creating an inclusive and empowering educational ecosystem. On the other hand, higher education has a strategic responsibility to strengthen research, innovation, and Pancasila values education. Universitas Pancasila, for example, places Pancasila education as a fortress against the challenges of globalization, radicalism, and terrorism. This collaboration strategy must be carried out in layers, from policymakers to implementers, so that education is truly able to produce a resilient generation.

Evaluation and monitoring are an integral part of a sustainable educational strategy. The literature shows that many educational policies fail due to a lack of a consistent evaluation mechanism. Evaluation does not only assess the final results but also the implementation process, the obstacles that arise, and the success of the strategies applied. Continuous monitoring allows for dynamic policy adjustments according to field needs. In the context of the era of disruption, which is full of uncertainty, a flexible and responsive evaluation system is a must.

Literature discussion shows that sustainable educational strategies in the era of disruption are not enough to only focus on technological aspects but must also pay attention to strengthening character and national values. The integration of digital technology, innovative curricula, character education, Pancasila values, and the concept of ESD is the key to success. Major challenges do exist, ranging from

access inequality to weak implementation in the field. However, the opportunities that are open are also very wide if educational strategies are designed holistically, participatively, and contextually with the needs of the nation. With such a strategy, education not only functions as a means of transferring knowledge but also as an instrument of social transformation. The resulting young generation is not only smart in utilizing technology but also has a positive character, strong national values, and awareness to maintain the sustainability of society and the environment. This is the essence of sustainable education that is expected to be able to answer the challenges and take advantage of the opportunities of the era of disruption.

5. Conclusion

The era of disruption has brought both great challenges and opportunities for education in Indonesia. Digital transformation, globalization, and rapid socio-economic changes require the education system to adapt comprehensively. From the results of the literature review, it can be concluded that a sustainable educational strategy must include the optimization of digital technology, the development of a competency-based curriculum relevant to the needs of the 21st century, the strengthening of character education, the instilling of Pancasila values, the integration of Education for Sustainable Development (ESD), and multi-party collaboration between families, schools, communities, and higher education.

Digital technology must be seen as a means to improve the quality of inclusive learning, not just a trend. However, the optimization of technology will only succeed if it is supported by strong educator capacity and an adaptive curriculum. On the

other hand, strengthening Pancasila-based character education becomes a fortress against the threat of radical ideologies that are increasingly easy to spread through digital media. The integration of national values, 4C skills, and sustainability awareness through ESD is an important foundation for forming a resilient younger generation. With a holistic and layered strategy, Indonesian education is expected to be able to produce a generation that is not only intellectually smart but also has strong character, is a person of integrity, and is able to face global changes wisely. Sustainable education in the era of disruption is ultimately not just a need but a prerequisite for maintaining the nation's resilience and the sustainability of civilization.

References

- Abdullah, A. (2017). Islam as a cultural capital in Indonesia and the Malay world: A convergence of Islamic studies, social sciences and humanities. *Journal of Indonesian Islam*, 11(2), 307-328.
- Al Muwali, A., Zaki, Y., & Mahdi, N. (2019). The Effectiveness of Social Media and Multimedia-Based Pedagogy in Enhancing Creativity among Art, Design, and Digital Media Students. *International Journal of Emerging Technologies in Learning*, 14(21).
- González-Salamanca, J. C., Agudelo, O. L., & Salinas, J. (2020). Key competences, education for sustainable development and strategies for the development of 21st century skills. A systematic literature review. *Sustainability*, 12(24), 10366.

- Grosseck, G., Țîru, L. G., & Bran, R. A. (2019). Education for sustainable development: Evolution and perspectives: A bibliometric review of research, 1992–2018. *Sustainability*, 11(21), 6136.
- Gul, R., & Khilji, G. (2021). Exploring the need for a responsive school curriculum to cope with the Covid-19 pandemic in Pakistan. *Prospects*, 51(1), 503-522.
- Herman, H. (2021). The transformation of educational management in the disruption era. *Taẖkir: Jurnal Penelitian Ilmu-ilmu Sosial dan Keislaman*, 7(1), 111-122.
- Hsu, C. L., Chen, M. C., & Lin, Y. H. (2017). Information technology adoption for sustainable development: green e-books as an example. *Information Technology for Development*, 23(2), 261-280.
- Karakainen, M. T., & Saikkonen, L. (2021). Multilevel analysis of the educational use of technology: Quantity and versatility of digital technology usage in Finnish basic education schools. *Journal of Computer Assisted Learning*, 37(4), 953-965.
- Liesa-Orús, M., Latorre-Coscolluela, C., Vázquez-Toledo, S., & Sierra-Sánchez, V. (2020). The technological challenge facing higher education professors: Perceptions of ICT tools for developing 21st century skills. *Sustainability*, 12(13), 5339.
- Lohmann, J., Breithecker, J., Ohl, U., Gieß-Stüber, P., & Brandl-Bredenbeck, H. P. (2021). Teachers' professional action competence in education for sustainable development: A systematic review from the perspective of physical education. *Sustainability*, 13(23), 13343.

- Mironenko, O., & Mironenko, E. (2020). Education against plastic pollution: current approaches and best practices. *Plastics in the Aquatic Environment-Part II: Stakeholders' Role Against Pollution*, 67-93.
- Subaidi, S. (2020). Strengthening character education in Indonesia: Implementing values from moderate Islam and the Pancasila. *Journal of Social Studies Education Research*, 11(2), 120-132.
- Syawaluddin, A., Afriani Rachman, S., & Khaerunnisa. (2020). Developing snake ladder game learning media to increase students' interest and learning outcomes on social studies in elementary school. *Simulation & Gaming*, 51(4), 432-442.
- Tillmanns, T. (2020). Learning sustainability as an effect of disruption. *Environmental Education Research*, 26(1), 14-26.