



Reconstruction of Sustainable Development through Education for Sustainable Development (ESD) to Strengthen National Resilience

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Abstract

Education for Sustainable Development (ESD) has become a strategic approach in supporting the achievement of the Sustainable Development Goals (SDGs) through the integration of environmental, social, cultural, policy, and technological transformation aspects within education. This study aims to analyze the trends of ESD research in Indonesia, Singapore and Japan based on several major themes, namely Culture and Social, Environmental and Energy, Policy and Regulation, and Technology and AI for Supporting ESD. The study employed a literature review approach by analyzing scientific articles from various national and international universities. The findings reveal that the implementation of ESD has evolved toward a multidisciplinary approach emphasizing the integration of local culture, ecological literacy, character education, educational policy, and digital transformation. Previous studies demonstrate that experience-based learning, inquiry learning, ethnopedagogy, and the utilization of Artificial Intelligence (AI) can enhance students' critical thinking, creativity, digital literacy, social awareness, and environmental responsibility. Furthermore, the successful implementation of ESD is strongly influenced by the synergy among educational policies, local cultural values, technological innovation, and active community participation. Therefore, ESD should not merely be understood as environmental education, but rather as a process of social transformation that supports holistic and contextual sustainable development.

[*Education for Sustainable Development* (ESD) menjadi pendekatan strategis dalam mendukung pencapaian *Sustainable Development Goals* (SDGs) melalui integrasi aspek lingkungan, sosial, budaya, kebijakan, serta transformasi teknologi dalam pendidikan. Kajian ini bertujuan menganalisis kecenderungan penelitian ESD di Indonesia, Singapura dan Jepang berdasarkan beberapa tema utama, yaitu *Culture and Social, Environmental and Energy, Policy and Regulation*, serta *Technology and AI for Supporting ESD*. Penelitian menggunakan pendekatan studi literatur dengan menganalisis artikel-artikel ilmiah dari berbagai perguruan tinggi nasional dan internasional. Hasil kajian menunjukkan bahwa implementasi ESD berkembang menuju pendekatan multidisipliner yang menekankan integrasi budaya lokal, literasi ekologis, pendidikan karakter, kebijakan pendidikan, dan transformasi digital. Penelitian-penelitian terdahulu menunjukkan bahwa pembelajaran berbasis pengalaman, *inquiry learning*, *ethnopedagogy*, dan pemanfaatan *Artificial Intelligence* (AI) mampu meningkatkan kemampuan berpikir kritis, kreativitas, literasi digital, kesadaran sosial, serta tanggung jawab lingkungan peserta didik. Selain itu, keberhasilan implementasi ESD dipengaruhi oleh sinergi antara kebijakan pendidikan, nilai budaya lokal, inovasi teknologi, dan partisipasi aktif masyarakat. Dengan demikian, ESD tidak hanya dipahami sebagai pendidikan lingkungan, tetapi juga sebagai proses transformasi sosial yang mendukung pembangunan berkelanjutan secara holistik dan kontekstual.] © The Authors.

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1. Introduction

The escalation of global issues related to sustainable development has positioned education as a strategic instrument in shaping adaptive, inclusive, and competitive societies. In this context, UNESCO's concept of Education for Sustainable Development (ESD) has emerged as an integrative approach that connects environmental, social, cultural, economic, technological, and policy dimensions within educational processes [1]. UNESCO emphasizes that ESD plays a crucial role in developing individuals who possess critical, collaborative, and reflective thinking skills, as well as the ability to make responsible decisions for future sustainability [2]. Therefore, strengthening ESD is not only relevant to the educational sector but also contributes strategically to national development and the enhancement of national resilience amid globalization, digital transformation, environmental crises, and increasingly complex social changes.

The articles published in this special edition of *Entita: Journal of Social Studies Education and Social Sciences* are part of the academic outcomes of the 2nd Renaisans International Conference on SDGs, organized by the Social Studies Education Department, Faculty of Tarbiyah and Teacher Training (FTIK), Universitas Islam Negeri Madura in collaboration with the Social Studies Alumni Association. This international conference carried the main theme, "Strengthening Education for Sustainable Development (ESD) in Realizing National Resilience," as an academic response to the urgency of strengthening sustainable education in supporting national resilience and achieving the Sustainable Development Goals (SDGs). The conference also functioned as a collaborative academic forum that brought together scholars, researchers, educators, policymakers, and practitioners from various institutions to discuss innovative educational strategies for addressing contemporary global challenges.

The discussions within the conference were classified into four major subthemes: Environmental and Energy for Supporting ESD, Culture and Social for Supporting ESD, Technology and AI for Supporting ESD, and Policy and Regulation for Supporting ESD. These subthemes demonstrate that the implementation of ESD requires a multidisciplinary approach that goes beyond formal learning boundaries. Sustainable education is not merely associated with strengthening environmental literacy, but also encompasses digital transformation, the optimization of local wisdom, social character development, and the harmonization of policies and regulations that support sustainability. This multidimensional orientation reflects the growing awareness that sustainable development can only be achieved through the integration of ecological responsibility, social justice, technological innovation, and cultural resilience within educational systems.

The research presented at this conference revealed a strong tendency toward the integration of digital technology and Artificial Intelligence (AI), the strengthening of local culture and social values, the development of ecological literacy, and the transformation of pedagogy into more participatory and contextual approaches. Within the technology and AI subtheme, several studies demonstrated that the use of digital platforms, microlearning, and interactive media can improve student engagement, critical thinking, creativity, and sustainability literacy. Meanwhile, the culture and social subtheme emphasized the importance of mutual cooperation, spirituality, local wisdom, and social solidarity as foundations for sustainable community development. On the other hand, the policy and regulation subtheme highlighted the urgency of harmonizing educational regulations with global ESD principles to ensure systematic, inclusive, and sustainable implementation.

Furthermore, the environmental and energy subtheme illustrated how renewable energy education, ecological literacy, and environmental awareness can be integrated into contextual learning practices that encourage students to participate actively in solving environmental problems. Several studies also highlighted the importance of experiential learning, inquiry-based learning, ethnopedagogy, and transformative pedagogy in building students' awareness of sustainability issues. These approaches indicate a paradigm shift from teacher-centered instruction toward student-centered learning that encourages collaboration, reflection, creativity, and active participation in addressing real-world challenges.

Another important finding emerging from the conference is the increasing integration of local culture and indigenous knowledge into ESD practices. Local wisdom, traditional ecological knowledge, spirituality, and community-based values are increasingly recognized as important foundations for strengthening sustainability education. In the Indonesian context, cultural traditions such as mutual cooperation (*gotong royong*), *pesantren*-based environmental movements, and ethnopedagogical approaches demonstrate that sustainable education can be contextualized according to local socio-cultural realities. This contextualization is important because sustainable education becomes more meaningful when learners are able to connect global sustainability issues with their local experiences and cultural identities.

In addition, several studies emphasized the growing role of digital transformation in shaping future educational practices. Artificial Intelligence, digital learning ecosystems, virtual collaboration platforms, and adaptive learning technologies are increasingly viewed as strategic instruments for supporting inclusive and accessible education. However, the studies also underline the importance of addressing ethical concerns related to AI, digital inequality, data security, and the need for strengthening digital literacy among teachers and students. Consequently, the development of technology-based education should not only focus on innovation and efficiency but also prioritize ethical responsibility, inclusivity, and human-centered educational values.

Based on this context, the articles presented in this international conference were comprehensively analyzed to identify research classifications, emerging trends, scholarly contributions, as well as the strengths and limitations of each study. This review is expected to provide an academic overview of the development of contemporary ESD research while also serving as a reference for the advancement of sustainable education in Indonesia and at the global level. More importantly, this special edition highlights that sustainable education is not solely about environmental preservation, but also about fostering socially responsible, culturally aware, technologically adaptive, and critically reflective generations capable of contributing to a more sustainable and peaceful future.

2. Method

This study employed a qualitative literature review approach by analyzing 49 selected manuscripts published in the 2nd *Renaissance International Conference on SDGs* and included in the special edition of *Entita: Journal of Social Studies Education and Social Sciences*. The analysis focused on identifying research trends, thematic classifications, methodological approaches, and scholarly contributions related to Education for Sustainable Development (ESD) [3]. The manuscripts were categorized into four major themes: Environmental and Energy for Supporting ESD, Culture and Social for Supporting ESD, Technology and AI for Supporting ESD, and Policy and Regulation for Supporting ESD. Data were analyzed descriptively and interpretatively to examine the tendency of contemporary ESD studies in integrating environmental awareness, local wisdom, technological transformation, social values, and educational policies within sustainable education practices. The findings were then interpreted to formulate an academic overview of the development of ESD research in supporting sustainable development and national resilience.

3. Results and Discussion

The studies conducted by Shirai and Nakamura demonstrate that the development of Education for Sustainable Development (ESD) in Japan shows a strong tendency toward reflection-based learning, historical experience, and social participation. Both studies position education as a strategic instrument for developing 21st-century competencies while supporting the achievement of the Sustainable Development Goals (SDGs), particularly SDG 4 on quality education and SDG 16 on peace, justice, and strong institutions. Sustainable education in both studies is directed not only toward academic achievement but also toward fostering social awareness, humanitarian values, and students' global responsibility.

Shirai's article, *The Global Significance of Integrated Studies Based on SDGs in Japan*, highlights the implementation of Integrated Learning Time within the Japanese education system as part of an inquiry-based curriculum reform. The study emphasizes the importance of integrating critical thinking, collaboration, media literacy, and social participation into the learning process. Education is positioned as a medium of social transformation that encourages students to actively engage in solving sustainability issues and promoting a culture of peace. A case study at Kinjo Gakuin Junior High School revealed that contextual learning based on real-world problems effectively enhanced students' reflective abilities and social awareness of global issues. Academically, Shirai's research is strengthened by its integration of educational policy analysis, OECD reports, and school-based learning practices, successfully demonstrating the relationship between inquiry-based

learning and the development of 21st-century competencies as well as SDG achievement. However, the study still has methodological limitations because it relies on a qualitative descriptive approach without providing empirical quantitative measurements regarding the effectiveness of the program in improving student competencies.

Meanwhile, Nakamura's article, *Boundary Crossing in Oral History: Co-Constructing a Sustainable Community of Peace Practice*, explores peace education through an oral history approach. The study employs the concept of boundary crossing to explain collaboration between younger generations and war survivors in constructing sustainable narratives of peace. The use of *Paintings of the Atomic Bomb (PAB)* as a boundary object demonstrates that history learning functions not merely as knowledge transfer, but also as a medium for reflection, intergenerational dialogue, and social perspective transformation. The study argues that history education becomes more meaningful when students actively participate in constructing narratives together with community members and war survivors. This approach highlights that peace education can serve as a mechanism for social reconciliation and the development of a sustainable culture of peace. Nevertheless, the theoretical complexity of the study makes it relatively difficult for nonacademic readers to understand, and its focus on the Hiroshima context limits the broader applicability of the findings to other regions.

Overall, both studies reveal several important trends in the development of ESD in Japan. First, there is a paradigm shift from memorization-based learning toward inquiry-based learning, critical reflection, and active student participation. Second, issues of peace, history, and social sustainability have become integral components of ESD implementation, positioning education as a transformative approach that encompasses social, cultural, and global ethical dimensions. Third, both studies demonstrate a strong tendency toward participatory and experiential learning approaches that directly involve students in identifying social problems and developing sustainable solutions. Therefore, these studies emphasize that effective sustainable education must integrate academic, social, cultural, and humanitarian dimensions in a holistic manner to develop critical, reflective, collaborative, and globally conscious generations.

3.1 Culture and Social for Supporting Education for Sustainable Development (ESD)

The theme *Culture and Social for Supporting Education for Sustainable Development (ESD)* demonstrates that sustainable education research in Indonesia increasingly emphasizes the integration of local culture, social values, spirituality, digital media, and ecological awareness as foundations for sustainable development. ESD is understood as a process of social transformation that develops knowledge, skills, values, and sustainable actions across social, cultural, economic, and environmental dimensions [4]. Various studies from Indonesian universities reveal that sustainable education is no longer limited to environmental education, but has evolved into a multidimensional approach rooted in culture and social experience.

Studies within this theme can be classified into five major focuses: the preservation of local culture, the utilization of creative and digital media, the strengthening of spirituality and social character, experience-based ecological education, and the development of sustainability awareness through community economic and social practices. Research conducted by Apdelmi from Universitas Jambi demonstrated that the historical site of Berhala Island can be utilized as a contextual learning medium to strengthen cultural identity and historical awareness among younger generations. These findings confirm that locality holds strong relevance in the implementation of history-based and educational tourism-oriented ESD.

The use of creative media in ESD is reflected in the study by Aldi Firnanda and colleagues from Universitas Islam Negeri Madura on the animated film *Gerakan Sadar Energi: Pulau Bintang*. The study revealed that visual media effectively promotes energy awareness and ecological responsibility among students through representations of renewable energy and environmentally friendly behavior. This approach demonstrates that digital media can simultaneously integrate cognitive, affective, and behavioral dimensions, particularly for digital-native generations.

The dimension of sustainable economics is evident in the study by Ni Putu Meita Krisdayanti and colleagues from Udayana University concerning *Cause-Related Marketing (CRM)* in small and medium enterprise products. The research showed that marketing activities can function as instruments of social and environmental education because modern consumers increasingly consider sustainability values and social responsibility in consumption decisions. These findings indicate that the creative economy sector possesses significant potential as a medium for nonformal sustainability education.

The strengthening of local culture as social capital for ESD is also visible in the study by Fathorrozy and colleagues regarding Madurese cultural values such as Bhuppa' Bhabhu' Ghuru Rato, Taneyan Lanjhang, and Tretan Dhibi. The study emphasized that local cultural values function as sources of social solidarity, collective trust, and community participation in sustainable development. Similar findings appeared in the study by Ida Bagus Weda Wigena and colleagues on the Puri and Griya habitus in Bali, which demonstrated that the transmission of language, arts, and family traditions serves as a form of informal education that preserves intergenerational cultural identity.

The dimensions of spirituality and character education emerged in the study by Sukron Mazid and colleagues concerning civic spirituality. The research demonstrated that spirituality-based character education strengthens values of tolerance, mutual cooperation, and social responsibility among students. Within the ESD perspective, sustainable development requires not only intellectual competence but also moral and humanitarian awareness manifested through school culture and social practices. Furthermore, studies on eco-habituation learning indicate that direct involvement in environmental activities can foster deeper ecological awareness through experiential learning approaches [5].

Overall, the articles within this theme demonstrate strong relevance to Indonesia's sociocultural context. Most studies successfully integrate local culture, spirituality, creative media, and community social practices into the ESD framework in contextual ways. This approach makes sustainable education more closely connected to societal realities, enabling sustainability values to be more easily internalized by learners. Another strength lies in the diversity of research approaches employed, ranging from ethnography and cultural studies to media studies and humanistic experience-based approaches.

Nevertheless, several studies still exhibit methodological limitations because they predominantly employ descriptive qualitative approaches, resulting in limited empirical measurement of ESD implementation impacts on students' behavioral change. In addition, some studies remain conceptual and have not yet demonstrated strong integration into formal educational policies or national curricula. Limitations in local context and the number of participants also reduce the generalizability of the findings.

Overall, research under the theme Culture and Social for Supporting Education for Sustainable Development indicates that the development of ESD in Indonesia is moving toward more contextual, participatory, and transformative approaches [6]. Local culture, digital media, spirituality, and social experience are positioned as important instruments for fostering students' sustainability awareness. These findings affirm that sustainable development can be achieved through synergy among education, culture, technology, and community social practices in a sustainable manner [2], [7].

3.2 Environmental and Energy for Supporting Education for Sustainable Development (ESD)

The theme Environmental and Energy for Supporting Education for Sustainable Development (ESD) demonstrates that sustainable education research in Indonesia is increasingly developing toward the integration of environmental issues, energy, local culture, and pedagogical transformation in supporting the achievement of the Sustainable Development Goals (SDGs). ESD is no longer understood merely as environmental education, but as a multidisciplinary approach connecting social, economic, cultural, renewable energy, and food security dimensions [1], [8]. Various studies emphasize that sustainable education should foster ecological awareness, social responsibility, and students' abilities to make sustainability-oriented decisions.

Studies within this theme can be classified into several major focuses, including sustainable economic education, the integration of local culture and ecological wisdom, environmental spirituality, transformative experience-based pedagogy, ecological literature, and renewable energy-based science learning. Research conducted by Anak Agung Istri Anom Bintang Pramawati and colleagues from Udayana University demonstrated that financial literacy and financial self-efficacy significantly influence women's sustainable financial behavior. The findings emphasize that family economic sustainability is an essential component of sustainable development, particularly in supporting poverty alleviation and inclusive economic growth [9]. These findings indicate that ESD can be developed through financial education oriented toward social and economic sustainability within families.

The integration of local culture into ESD is reflected in the study by Ahmad Makmun Khodori and Sakilah from Universitas Islam Negeri Sultan Syarif Kasim Riau. The research demonstrated that Riau Malay local wisdom, such as *Lubuk Larangan* and Malay pantun, contains environmental conservation values and social ethics relevant to sustainable education. The integration of local culture into learning processes has been proven to enhance students' environmental empathy and

scientific literacy [10], [11]. These findings reveal that ethnopedagogy based on local culture holds a strategic position in supporting contextual and humanistic ESD implementation [12].

The dimension of ecological spirituality is evident in the bibliometric study conducted by Abd Mannan and colleagues from Universitas Islam Negeri Madura regarding Islamic education and the environment. Research analyzing 2,119 Scopus-indexed articles from 2015–2025 identified dominant themes such as eco-theology, green curriculum, and place-based learning. This study confirms that environmental crises have encouraged the development of ecological spirituality-based educational approaches as part of sustainable educational transformation. This perspective demonstrates that environmental education is oriented not only toward scientific aspects but also toward society's moral and religious awareness.

Food security and indigenous ecological culture are highlighted in Ita Rodiah's study concerning the representation of the Baduy community's *Leuit* in contemporary literature. The study demonstrated that the traditional Baduy food storage system represents a form of ecological wisdom adaptive to food crises. The concepts of *Pikukuh* and respect for Dewi Sri are understood as forms of eco-theology connecting spirituality with environmental conservation. These findings reveal that indigenous communities possess ecological knowledge relevant to modern sustainable development.

The pedagogical dimension of ESD is reflected in the study by Yolandia Dwi Wulansari and Ardi Wina Saputra on the implementation of Discovery Learning in literature education. The research demonstrated that discovery-based approaches improve cultural literacy, critical thinking skills, and students' interpretative abilities. Improved student learning outcomes indicate that active learning is more effective in supporting culture-based ESD objectives than conventional approaches [13]. These findings align with experiential learning concepts emphasizing the importance of direct experience in educational processes.

Meanwhile, the study by Novia Shafa Dwijayanti and Aldi Firnanda regarding environmental narratives in the novels of Ahmad Tohari demonstrates that literature can serve as an effective medium for ecological education. Representations of human-nature relationships within literary works can foster students' social reflection and environmental awareness in emotional and contextual ways. This study indicates that ecological literacy can be developed not only through science but also through humanities and cultural approaches.

The integration of renewable energy into science learning is visible in the study by Nur Aini Lathifah Widad and Hadma Yuliani concerning guided inquiry-based physics learning. The research demonstrated that learning activities connected to renewable energy contexts effectively improve students' Higher Order Thinking Skills (HOTS). These findings suggest that contextual green-energy-based learning possesses substantial potential in supporting science- and technology-based ESD.

Furthermore, studies on Eco-Pesantren and the digital application *SampahKita* at Mambaul Ulum Bata-Bata Islamic boarding school provide examples of community-based ESD implementation. The research demonstrated that pesantren-based environmental education can foster students' ecological behavior through 5R activities, maggot cultivation, and technology-based waste management. Support from digital applications significantly increased student participation in environmental conservation efforts [14], [15].

Overall, the articles within this theme demonstrate strong relevance to global sustainability issues and Indonesia's sociocultural context. Most studies successfully integrate environmental dimensions, local culture, renewable energy, and pedagogical transformation into contextual ESD frameworks. This approach shows that sustainable education is not merely theoretical but also practical and closely connected to community realities. Another strength lies in the diversity of methodological approaches employed, ranging from quantitative methods and bibliometric studies to literary analysis and ethnopedagogy.

Nevertheless, several methodological limitations remain. Most studies employ descriptive approaches, resulting in limited comprehensive measurement of long-term impacts on students' ecological behavioral changes. In addition, limited sample sizes and localized research contexts reduce the generalizability of findings. Some studies also remain conceptual and have not yet been strongly integrated into formal educational policies or national curriculum development.

Based on the overall review, several major trends can be identified in the development of environment- and energy-based ESD in Indonesia. First, there is a strong integration between environmental education, local culture, and community spirituality. Second, transformative experience-based pedagogy involving active student participation in understanding environmental issues is increasingly developing. Third, renewable energy and ecological literacy are becoming central concerns within science education. Fourth, ESD is evolving into a multidisciplinary approach

that holistically connects environmental, cultural, economic, literary, and social transformation dimensions.

Overall, research under the theme Environmental and Energy for Supporting Education for Sustainable Development indicates that sustainable education in Indonesia is moving toward more contextual, participatory, and multidisciplinary approaches. The integration of local culture, renewable energy, ecological literacy, and educational technology demonstrates that sustainable development requires synergy among scientific knowledge, cultural values, social transformation, and community ecological awareness [7].

3.3 Policy and Regulation for Supporting Education for Sustainable Development (ESD)

The theme Policy and Regulation for Supporting Education for Sustainable Development (ESD) demonstrates that the implementation of sustainable education in Indonesia is increasingly developing toward a multidisciplinary approach integrating regulation, character education, digital literacy, local culture, inclusive education, and social resilience. Various studies from Indonesian universities indicate that ESD is no longer understood merely as environmental education, but as a broader strategy for social development connecting law, culture, technology, and humanitarian values to support the achievement of the Sustainable Development Goals (SDGs) [2]. These studies reveal that sustainable education requires strong policy support, cultural integration, and social participation to create adaptive and resilient communities.

The studies within this theme can be classified into several major focuses, including the harmonization of sustainable education policies, strengthening local cultural and social values, digital literacy and technological ethics, inclusive education, and social character development. Research conducted by Raesitha Zildjianda and Dian Herlambang emphasizes the importance of integrating ESD regulations into the national legal system to ensure that sustainable education is implemented systematically and coherently. Their normative-juridical approach demonstrates that educational policy plays a strategic role in aligning national development goals with the global sustainability agenda.

The social and cultural dimensions of ESD are reflected in the study by Yeti Nurizzati and Nindy Praditha Ayu on the *sedekah kubur* tradition as a medium for preserving mutual cooperation and community solidarity. The study highlights those local traditions function as social instruments for strengthening social cohesion and cultural sustainability. Similar findings are presented in Akh. Syaiful Rijal's research on *pesantren tahfidz* as a form of soft infrastructure for national resilience grounded in religious and social values. Using Michel Foucault's genealogical approach, the research explains that Islamic boarding schools' function not only as religious institutions but also as spaces for social discipline, morality formation, and community resilience.

Digital transformation also emerges as a significant issue in ESD development, particularly regarding technological ethics and the quality of social interaction [16]. Alfina Nurlaili Rosyidah's study on the phenomenon of phubbing demonstrates that excessive digital technology use can reduce social communication quality and individual empathy. Meanwhile, research by Arif Sobirin Wibowo and colleagues on the integration of Pancasila Education and digital literacy argues that the Society 5.0 era requires technological ethics grounded in humanitarian and national values. These findings indicate that digital transformation in education must be accompanied by ethical and social awareness to prevent the weakening of social relationships.

The dimensions of inclusive education and social character development are evident in the study by Nurul Qomariyah and Siti Azizah on the Montessori approach in inclusive education. Their findings suggest that sustainable education should promote diversity, empathy, and adaptive learning environments for all students. This perspective is reinforced by Jaka Rizkiawan Harianda and colleagues, who emphasize the role of social studies teachers in preventing student violence through character education and social cohesion. The research highlights that social education plays an important role in fostering tolerance, responsibility, and collective awareness among students.

In addition, the study by Ubaidillah Rohim and Arinal Haq Fauziah on the Free Nutritious Meal Program (Program Makan Bergizi Gratis/MBG) reveals that the success of educational and welfare policies is influenced not only by material support but also by students' psychological well-being and subjective learning experiences. This finding indicates that educational policies within the ESD framework should consider emotional well-being and learning quality as integral components of sustainable development.

Overall, the articles within this theme demonstrate significant strengths in terms of multidisciplinary perspectives and relevance to contemporary sustainability challenges in Indonesia. Studies on ESD policy harmonization provide systematic normative and juridical analyses, while research on local culture and community practices offers contextual insights through ethnographic

approaches. Furthermore, studies on digital literacy and phubbing contribute to understanding the social consequences of technological transformation in modern society.

Nevertheless, several methodological limitations remain apparent. Most studies rely heavily on descriptive qualitative and conceptual approaches, resulting in limited empirical measurement of policy effectiveness and educational outcomes. In addition, many studies are conducted within limited local contexts and small respondent groups, reducing the generalizability of findings. Some studies also employ highly theoretical frameworks that may be difficult for non-academic audiences to comprehend.

Based on the overall findings, several major trends can be identified in the development of ESD-related policy and regulation research in Indonesia. First, sustainable education is shifting from an environmentally oriented paradigm toward a multidimensional approach encompassing regulation, culture, technology, and social resilience. Second, local cultural values such as mutual cooperation, pesantren traditions, and community solidarity are increasingly recognized as foundations for sustainable social development. Third, digital transformation has become a strategic concern in sustainable education, making digital literacy and technology ethics based on Pancasila values increasingly important. Fourth, inclusive education and social character development are emerging as key instruments for strengthening empathy, tolerance, and social cohesion among students.

In conclusion, research under the theme Policy and Regulation for Supporting Education for Sustainable Development contributes significantly to expanding the discourse of ESD in Indonesia. The studies demonstrate that the success of sustainable development depends not only on formal regulations but also on the capacity of educational institutions and communities to integrate social, cultural, and ethical values into everyday life. Therefore, the implementation of ESD requires synergy among regulation, education, culture, and technology to build adaptive, humanistic, and sustainable societies [17].

3.4 Technology and AI for Supporting Education for Sustainable Development (ESD)

The theme Technology and AI for Supporting Education for Sustainable Development (ESD) demonstrates that digital transformation has become a strategic instrument in advancing sustainable education in Indonesia. Various studies from Indonesian universities emphasize that digital technology, Artificial Intelligence (AI), microlearning, and interactive learning platforms are no longer positioned merely as instructional media, but as tools for strengthening 21st-century competencies such as critical thinking, creativity, collaboration, digital literacy, and sustainability awareness. Within the ESD framework, technology is utilized to develop learning environments that are more adaptive, participatory, and contextual in addressing global challenges.

Studies within this theme can be classified into several major focuses, including the development of digital learning media, AI-based personalized learning, the enhancement of Higher Order Thinking Skills (HOTS), the integration of technology with local cultural values, and technology-based social empowerment. Research conducted by Aulia Amatullah and colleagues from Universitas Negeri Malang on Google Sites-based learning media indicates that students are more engaged in interactive learning environments that present real-world cases and support digital collaboration. The study demonstrates that digital platforms significantly improve students' learning motivation and classroom participation. These findings suggest that technology is capable of creating more flexible and student-centered learning environments.

The use of AI for personalized learning is reflected in the research by Vidiani Br. Sembiring and colleagues from Universitas Negeri Medan on AI-based e-portfolios. The study reveals that AI significantly enhances self-regulated learning and independent learning skills among elementary school students. Similar findings are presented by Arinal Haq Fauziah and Ishlakhatu Saidah from Universitas Islam Negeri Madura, who argue that the effectiveness of digital microlearning is strongly influenced by students' ability to manage their own learning processes independently. Within the ESD perspective, autonomous learning abilities are considered a crucial component of lifelong learning, which serves as the foundation of sustainable education.

The dimension of strengthening HOTS through digital technology is evident in the study conducted by Saiful Amin and colleagues from Universitas Islam Negeri Maulana Malik Ibrahim regarding the use of web-based Geopedia learning. Their findings demonstrate that digital learning significantly improves students' spatial thinking abilities. Meanwhile, research by Moh Khalid Hasan and colleagues from Universitas Islam Negeri Madura indicates that the use of ChatGPT, Canva, and Edpuzzle enhances students' creativity, engagement, and critical thinking skills within ESD-oriented learning. Furthermore, research by Ettyani and Ichwan Bagus Airlangga reveals that AI-

supported scaffolded academic reading effectively improves university students' sustainability reasoning regarding global sustainability issues. These findings indicate that AI has strong potential to strengthen students' analytical and reflective capacities toward social and environmental problems.

Beyond academic competency development, several studies also highlight efforts to integrate technology with local cultural values and inclusive education. Research conducted by Ahmad Imam Khairi and colleagues demonstrates that AI-based ethnopedagogy can connect modern technology with local cultural values in ESD-oriented social studies learning [18]. This approach suggests that digital transformation in Indonesia does not entirely adopt global paradigms but instead contextualizes technological advancement through local wisdom and cultural traditions. In addition, research by Ratna Puspitasari and colleagues concerning women with disabilities in digital-based micro, small, and medium enterprises (MSMEs) illustrates that digital transformation can also function as a tool for inclusive social and economic empowerment.

Overall, the articles within this theme demonstrate considerable strengths in terms of relevance to 21st-century educational needs and the Sustainable Development Goals (SDGs). Most studies successfully connect digital technology with the enhancement of creativity, digital literacy, critical thinking skills, and sustainability awareness among students. Another significant strength lies in the diversity of methodological approaches employed, ranging from quantitative experimental methods to phenomenological and qualitative studies. For example, the research conducted by Etyani and Ichwan Bagus Airlangga possesses strong methodological value because it combines quantitative and qualitative approaches, providing a more comprehensive understanding of the effectiveness of AI-based learning.

Nevertheless, several limitations remain apparent within these studies. Most research is conducted within localized contexts and involves relatively limited sample sizes, resulting in weak generalizability of findings. In addition, several studies remain descriptive or literature-based and therefore do not provide sufficiently strong experimental evidence regarding the long-term effectiveness of AI implementation in education. Critical issues such as AI ethics, data security, and technological access inequality are also insufficiently explored, despite their significance in the implementation of educational technology in the digital era. Some studies have not yet examined the psychological and ethical implications of AI usage for students, particularly in early childhood education contexts.

Based on the overall findings, several major trends can be identified in the development of research under the theme Technology and AI for Supporting ESD. First, AI is increasingly positioned as a personalized learning instrument that supports student-centered learning approaches. Second, digital technology is directed toward strengthening HOTS, creativity, and digital literacy as key competencies of the 21st century. Third, there is a growing tendency to integrate modern technology with local culture through ethnopedagogical approaches. Fourth, technology-based education is evolving toward transformative learning that focuses not only on knowledge transfer but also on the development of social awareness, environmental responsibility, and critical reflection on global sustainability issues [19].

In conclusion, research under the theme Technology and AI for Supporting Education for Sustainable Development contributes significantly to the advancement of sustainable education in Indonesia. Digital transformation has proven capable of creating more interactive, inclusive, and adaptive learning environments while simultaneously strengthening students' 21st-century competencies. However, the successful implementation of educational technology depends heavily on teachers' readiness, students' digital literacy, educational policy support, and careful consideration of ethical and inclusive technological practices. Therefore, the development of AI-based education should be conducted critically, humanistically, and sustainably to support the achievement of sustainable development goals while strengthening the quality of national education in the era of digital transformation.

4. Conclusion

Overall, studies on Education for Sustainable Development (ESD) demonstrate that sustainable education is evolving toward a more holistic, contextual, and transformative approach through the integration of local cultural values, social experiences, digital technology, renewable energy, and adaptive educational policies. The implementation of ESD in both Japan and Indonesia highlights the importance of participatory, reflective, collaborative, and experiential learning in fostering 21st-century competencies, ecological awareness, and cultures of peace and sustainability. Furthermore, the success of ESD is strongly influenced by the synergy among curriculum development, educational regulations, technological innovation, humanitarian values, and active

community participation in addressing social and environmental challenges. Therefore, these studies collectively contribute significantly to the advancement of global sustainable education while strengthening efforts to cultivate critical, humanistic, adaptive, and socially responsible generations committed to sustainable development.

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