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Integrating Artificial Intelligence and Ethnopedagogy in ESD: A Conceptual Model for Social Studies Learning and National Resilience

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Abstract

Education for Sustainable Development (ESD) is increasingly playing a crucial function in the global context in tackling environmental crises, technological disruption and transformation of society that threaten sustainable national resilience. Nevertheless, the utilization of ESD for social studies education is not prevalent, particularly for the integration of AI with local wisdom values. The research will analyze the ESD strengthening in social studies learning through the intersection of AI and ethnopedagogy. A literature review methodology, analysing pertinent scholarly publications published in the previous ten years, took an analytical-critical approach to the research. The results can be divided into three broad topics. AI facilitates ESD through adaptive learning, increased accessibility, and data-driven instructional practices. Second, ethnopedagogy deepens contextual understanding of learning to include local cultural values and community-derived knowledge in the process of learning. Third, the developed Artificial Intelligence–Ethnopedagogy for Sustainable Development (AIE-ESD) model integrates AI-driven learning approaches, sustainability competencies, and ethnopedagogical approaches across a holistic framework. The novelty of the AIE-ESD model is the convergence of adaptive digital technology with culturally responsive pedagogy in the effort to advance contextual, sustainability-oriented, and socially grounded social studies education in the facilitation of long-term national resilience.

[Pendidikan untuk Pembangunan Berkelanjutan (ESD) semakin memainkan peran penting dalam konteks global dalam menangani krisis lingkungan, disrupsi teknologi, dan transformasi masyarakat yang mengancam ketahanan nasional yang berkelanjutan. Meskipun demikian, pemanfaatan ESD dalam pendidikan ilmu sosial belum meluas, terutama dalam hal integrasi kecerdasan buatan (AI) dengan nilai-nilai kearifan lokal. Penelitian ini akan menganalisis penguatan ESD dalam pembelajaran ilmu sosial melalui perpaduan antara AI dan etnopedagogi. Metodologi tinjauan literatur, yang menganalisis publikasi ilmiah relevan yang diterbitkan dalam sepuluh tahun terakhir, menggunakan pendekatan analitis-kritis dalam penelitian ini. Hasilnya dapat dibagi menjadi tiga topik utama. AI memfasilitasi ESD melalui pembelajaran adaptif, peningkatan aksesibilitas, dan praktik pengajaran berbasis data. Kedua, etnopedagogi memperdalam pemahaman kontekstual pembelajaran dengan memasukkan nilai-nilai budaya lokal dan pengetahuan yang berasal dari komunitas ke dalam proses pembelajaran. Ketiga, model Artificial Intelligence–Ethnopedagogy for Sustainable Development (AIE-ESD) yang dikembangkan mengintegrasikan pendekatan pembelajaran berbasis AI, kompetensi keberlanjutan, dan pendekatan etnopedagogi dalam kerangka holistik. Keunikan model AIE-ESD terletak pada konvergensi teknologi digital adaptif dengan pedagogi yang responsif terhadap budaya dalam upaya memajukan pendidikan ilmu sosial yang kontekstual, berorientasi pada keberlanjutan, dan berakar pada masyarakat dalam memfasilitasi pembelajaran jangka panjang.]

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1. Introduction

Education for Sustainable Development (ESD) has developed into one of the most strategic global agendas in responding to the complexity of the multidimensional crises of the 21st century, which include environmental degradation, climate change, socio-economic inequality, and accelerating and unpredictable technological disruptions. Within this framework, education is no longer understood simply as a process of knowledge transmission, but as an instrument of social transformation that plays a role in shaping individual and collective capacities to think systemically, act reflectively, and make decisions that are responsible for the sustainability of human life and the environment [1], [2]. ESD demands a paradigm shift in education from a linear and content-based approach to a holistic, participatory, and action-oriented approach.

In the Indonesian context, the urgency of implementing ESD is becoming increasingly relevant considering that the development challenges faced are complex and multi-layered, ranging from ecological vulnerabilities, inequality of development between regions, to socio-cultural dynamics influenced by globalization and digitalization. Therefore, education has a strategic role not only in improving the quality of human resources, but also in strengthening national resilience that includes social, cultural, economic, and environmental dimensions. National resilience in this perspective is not only interpreted as the ability to survive, but also as adaptive and transformative capacity in the face of global change in a sustainable manner.

Nevertheless, the implementation of ESD in educational practices in Indonesia, especially in Social Sciences (IPS) learning, still faces various structural and pedagogical challenges. Social studies learning, which should be a strategic space to discuss social and sustainability issues contextually, in practice still tends to be oriented towards mastery of the material and memorization of concepts. This approach results in limited space for students to develop critical, reflective, and participatory thinking skills in understanding and responding to sustainability issues they face in their daily lives [3], [4]. Dengan demikian, terdapat kesenjangan yang cukup signifikan antara tujuan normatif ESD dengan praktik pembelajaran yang berlangsung di kelas.

On the other hand, the development of digital technology, especially artificial intelligence (AI), has brought significant changes in the global education landscape. AI offers a variety of innovations in learning, such as adaptive learning systems, learning analytics, and intelligent tutoring systems, which enable the learning process to be more personalized, efficient, and data-driven [5], [6]. This technology has the potential to support the achievement of ESD goals by providing a more flexible and responsive learning experience to the individual needs of learners. However, the dominance of technocentric approaches in the use of AI often ignores the dimensions of values, ethics, and socio-cultural context, which are precisely the essence of sustainability education.

A number of critical studies show that the use of AI in education is inseparable from various challenges, such as the potential for algorithmic bias, the reduction of human interaction in learning, and the gap in access to technology that can widen educational inequalities [7]. In the context of ESD, the use of technology that is not balanced with a strong value framework has the potential to obscure the purpose of education itself. Therefore, an approach is needed that not only integrates technology technically, but is also able to direct its use within a contextual and humanistic framework of sustainability values.

Within this framework, ethnopedagogy offers a relevant perspective as an approach that places local wisdom and cultural practices of the community as a source of meaningful learning. Ethnopedagogy emphasizes the importance of contextualizing learning by relating teaching materials to the social and cultural realities of students, so that the learning process becomes more relevant, reflective, and meaningful [8]. In Indonesia's rich cultural context, this approach has great potential to internalize long-lived sustainability values in people's social practices.

In particular, in the Madura context, values such as mutual cooperation, social solidarity (taretan dhibi'), and wisdom in local resource management reflect sustainability principles that can be integrated into social studies learning. These values not only have a cultural dimension, but are also relevant to efforts to build ecological and social awareness of students. Previous research has shown that the integration of local wisdom in learning can increase student engagement, strengthen cultural

identity, and encourage more contextual learning [9], [10]. However, the main challenge lies in how to integrate these values with modern technology to remain relevant to the times.

The results of the literature review show that ESD, artificial intelligence, and ethnopedagogy have been developing as relatively separate domains. ESD serves as a normative framework that provides educational direction, AI as a technological innovation that transforms the learning process, and ethnopedagogy as a cultural approach that strengthens local contexts. However, there have not been many studies that integrate these three dimensions simultaneously in one comprehensive learning framework, especially in the context of social studies learning. This fragmentation shows a significant conceptual gap and opens up space for the development of a more holistic integrative model.

To develop an overall concept from this data, this article seeks to include AI and ethnopedagogy into a framework of Education for Sustainable Development (ESD) in social studies learning. More specifically, this study presents the AI–Ethnopedagogy Integrated ESD Learning Model (AIE-ESD Model) as a unique methodology for improving sustainability education while supporting national resilience. The major novelty of this work comes from the multidimensional combination of technology, pedagogy, the collective knowledge of the local community, and the recasting of the role of artificial intelligence beyond a technological tool, as a pedagogical mediator that serves the growth of students' critical consciousness and sustainability capacity. Therefore, this article is anticipated to provide a theoretical advance on the construction of more integrative, context-specific ESD studies and to pave the road for the evolution of adaptive, reflective and sustainability-oriented learning practices in Indonesia.

2. Method

This research uses a conceptual approach (theoretical paper) with analytical-critical literature review methods. This approach was chosen because the main purpose of the research was not to test hypotheses through field data, but to build a theoretical synthesis regarding the integration of artificial intelligence, ethnopedagogy, and Education for Sustainable Development (ESD) in social studies learning. In conceptual articles, the review of literature serves not only as a theoretical foundation, but also as an instrument for finding gaps, connecting different concepts, and generating new conceptual models [11].

Research data were derived from scientific articles listed on reliable databases (e.g., Scopus, Web of Science, and SINTA-indexed journals). Other supporting studies were acquired from Google Scholar to identify relevant publications not yet indexed in the most prominent databases. We screened all literature for this review covering only research published 2015–2025 pertaining to Education for Sustainable Development (ESD), applied models of artificial intelligence in education, ethnopedagogy, local wisdom, and social studies learning. During the preliminary search, 186 articles were found. After deleting duplicate and non-accessible documents, 142 articles remained for screening. Abstract screening and full-text assessment were then performed with inclusion criteria covering topics of interest (e.g., relevance/acceptability of source), quality, and theoretical contributions. From this process, 52 articles were eligible for thematic synthesis. However, in order to ensure analytical depth and conceptual focus, this study additionally identified 10 core articles which were, in a way, the most pertinent to integrating artificial intelligence (AI), ethnopedagogy, and ESD into social studies instruction. These papers became the main initial basis with which to develop the AIE-ESD conceptual model.

The search process was carried out systematically using a combination of keywords, including "Education for Sustainable Development", "artificial intelligence in education", "ethnopedagogy", "social studies learning", "local wisdom", and "national resilience". After the initial search process, articles are selected based on three main criteria, namely: (1) they have direct relevance to the focus of the study; (2) published in a reputable journal; and (3) contain significant conceptual and empirical contributions. The selection process is carried out through the stages of identification, abstract screening, full reading, and theme classification. These stages are important to ensure that only truly relevant and credible sources are used in the development of conceptual models. This kind of approach is commonly used in literature review because it can increase the accuracy and transparency of research [12].

The data that has been collected is analyzed using thematic synthesis techniques. In the initial stage, open coding was carried out to identify key concepts that emerged from various literature, such as the sustainability dimension, AI-based learning personalization, the value of local wisdom, and national resilience competencies. Furthermore, these concepts are grouped through axial coding into broader themes, namely ESD, artificial intelligence, ethnopedagogy, and social

studies learning. The last stage is in the form of selective coding, which is compiling the relationship between themes so as to form a complete and coherent framework of thought. This technique was chosen because it allows researchers not only to summarize findings, but also to generate new interpretations that go beyond individual studies separately [13], [14].

Besides thematic analysis, this research used critical analysis to discuss the benefits and drawbacks of AI and ethnopedagogical practices in the area of education. The analysis emphasized problems of algorithmic bias, digital inequality, and the potential decline of humanistic values within AI-mediated learning, but it also acknowledged that ethnopedagogy helps to maintain cultural identity even if it adapts little to the changing technological paradigm. Developing the AI–Ethnopedagogy Integrated ESD Learning Model (AIE-ESD Model) using this synthesis, the study places ESD as the key framework underpinned by artificial intelligence and ethnopedagogy with regard to social studies learning. This model has been developed with theoretical foundations and practical implications for sustainability-based education in Indonesia, specifically in the socio-cultural context of Madura, according to Hannah Snyder's perspective on literature review as a research methodology.

Table 1. Coding and Thematic Synthesis Framework

Coding Stage	Main Focus	Example Findings from Literature	Resulting Theme
Open Coding	Identification of recurring concepts	AI personalization, adaptive learning, sustainability literacy, local wisdom values	Initial Concepts
Open Coding	Identification of educational challenges	Digital divide, algorithmic bias, weak cultural integration	Educational Issues
Axial Coding	Grouping related concepts	AI-based learning systems	Artificial Intelligence
Axial Coding	Grouping cultural dimensions	Local wisdom, contextual learning, indigenous knowledge	Ethnopedagogy
Axial Coding	Grouping sustainability dimensions	Ecological awareness, social responsibility, resilience	ESD Competencies
Selective Coding	Integrating all themes	Integration of AI, ethnopedagogy, and ESD	AIE-ESD Model
Critical Analysis	Evaluating strengths and limitations	Humanistic concerns vs technological efficiency	Integrative Educational Framework

Source: data processed by the author (2026)

3. Results

3.1 Literature Synthesis Results: Integrative Thematic Mapping

Based on the results of literature searches from the Scopus, Web of Science (WoS), and SINTA databases (ranked 1st and 2nd) in the 2015–2025 period, a number of articles were obtained that substantially discussed three main domains, namely Education for Sustainable Development (ESD), artificial intelligence in education, and ethnopedagogy. The selection process is carried out through systematic stages that include initial identification, abstract-based screening, full-text evaluation, and thematic classification. From the overall literature analyzed, it was found that the three domains developed dynamically, but still showed a tendency to fragment in implementation and theoretical studies.

In general, the literature on ESD emphasizes the importance of transforming education from a traditional approach to a more participatory, reflective, and action-oriented approach. The expected sustainability competencies include not only knowledge, but also systemic thinking skills, collaborative skills, and ethical awareness of the environment and society [5], [15]. However, in practice, the implementation of ESD in various countries, including Indonesia, still faces obstacles in terms of curriculum integration and pedagogical readiness of teachers.

On the other hand, the literature on artificial intelligence in education shows very rapid development, especially in terms of learning personalization, learning data analysis, and the development of intelligent tutor systems. Studies show that AI is able to improve learning efficiency and provide a more adaptive learning experience to the individual needs of learners [6]. However, the dominance of technocentric approaches in the use of AI often ignores the value dimension and socio-cultural context, which is precisely the essence of sustainability education.

Meanwhile, the study of ethnopedagogy emphasizes the importance of integrating local wisdom in the learning process as an effort to increase the relevance and meaningfulness of education. In the context of a multicultural Indonesia, this approach has great potential to internalize long-lived sustainability values in people's cultural practices [16], [17], [18], [19]. However, the main

limitation of this approach is the lack of integration with modern technology, so it is often considered less adaptive to the times.

3.2 Comparative Analysis of the Literature

To strengthen the results of the synthesis, the following is presented a more comprehensive table related to the results of the literature analysis:

Table 2. Comparative Analysis of Key Literature on ESD, AI, and Ethnopedagogy

No	Author(s) & Year	Focus Area	Main Contribution	Key Findings	Limitations / Gaps
1	Rieckmann (2018)	ESD	Sustainability competencies framework	Emphasizes competencies beyond cognitive (skills, values, attitudes)	Lacks operational integration with technology and local context
2	Wals (2015)	ESD	Transformative learning approach	Promotes reflective, critical, and holistic learning	Normative, limited practical implementation guidance
3	Tilbury (2011)	ESD	ESD pedagogical framework	Highlights participatory and critical pedagogy	Does not address digital or AI integration
4	UNESCO (2020)	ESD	Global policy framework	Positions ESD as a global educational agenda	Macro-level, lacks contextual and technological application
5	Holmes et al. (2019)	AI in Education	AI for adaptive learning	AI supports personalization and adaptive systems	Limited ethical and cultural considerations
6	Zawacki-Richter et al. (2019)	AI in Education	Systematic review of AI use	Dominance of AI in learning analytics	Focus more on technical aspects than pedagogy
7	Selwyn (2019)	AI in Education	Critical AI perspective	Highlights risks: bias, dehumanization	Does not propose integrative pedagogical solutions
8	Aulia (2024); Rahmiati (2025)	Ethnopedagogy	Local wisdom integration	Improves student engagement and relevance	Limited linkage with digital/AI innovation
9	Tahir (2025); Marwan (2025)	Ethnopedagogy	Culture-based learning	Strengthens contextual understanding and identity	Still traditional, lacks technological adaptation
10	Nurkanti (2026)	ESD in Social Studies	Integration of sustainability in IPS	IPS as a strategic integrative subject (social, economic, cultural)	No explicit integration of AI and local wisdom simultaneously

Source: data processed by the author (2026)

Based on Table 1, it can be seen that the development of studies on Education for Sustainable Development (ESD), artificial intelligence (AI), and ethnopedagogy shows significant contributions, but it is still sectoral and not fully integrated. A comparative analysis of the ten key articles reveals the thematic patterns as well as conceptual gaps that are the basis for the development of the model in this study.

First, from a literature group focused on ESD, such as Rieckmann (2018) [20], Wals (2015), UNESCO (2020) [1], and Tilbury (2011) [21], it can be concluded that ESD is consistently positioned as a transformative approach to education. Rieckmann (2018) emphasizes the importance of sustainability competencies that go beyond cognitive aspects, while Wals (2015) [2] and Tilbury (2011) [3] highlighting the need for a reflective, critical, and holistic approach to learning. UNESCO (2020) [1] strengthening this position by placing ESD as a global agenda in the education system. However, the literature in this group tends to be normative and does not provide concrete operational guidance related to the integration of technology and local contexts in learning practices.

Second, in the literature group that discusses artificial intelligence in education, such as Holmes et al. (2019) [22], Zawacki-Richter et al. (2019) [6], and Selwyn (2019) [7], found that AI has great potential in improving the quality of learning, particularly through personalization and analysis of learning data. Holmes et al. (2019) [5] show that AI is capable of supporting adaptive learning, while Zawacki-Richter et al. (2019) [6] through systematic review identifies the dominance of the use of AI in learning analytics. However, Selwyn (2019) [7] provides a critical perspective by highlighting the potential for algorithmic bias and the risk of dehumanization in AI-based education. This shows that while AI offers significant technological innovation, its use still requires a strong value framework to avoid getting caught up in a technocentric approach.

Third, in ethnopedagogical literature groups, such as Aulia (2024) [23], [24], [25] and Rahmiati (2025) [26], It was found that the integration of local wisdom in learning has been proven to be effective in increasing the relevance and engagement of learners. Tahir (2025) [9] shows that learning based on local culture is able to improve contextual understanding, while Marwan (2025) [27] emphasizing the role of ethnopedagogy in strengthening the cultural identity of students. However, this approach still faces limitations in terms of adapting to technological developments, so it tends to be separate from rapidly developing digital innovation.

Fourth, Nurkanti's study (2026) [28] which focuses on ESD-based social studies learning shows that social studies has a strategic position as a vehicle for integrating sustainability values. Social studies allows the incorporation of social, economic, and cultural dimensions in one learning framework. However, this research has not explicitly integrated aspects of technology and local wisdom simultaneously, so there is still room for further development.

Overall, this comparative analysis reveals a pattern of fragmentation in the literature, where ESD develops as a normative framework, AI as a technological innovation, and ethnopedagogy as a cultural approach, but has not been integrated into a single complete learning model. This gap is the basis for the argument in this study to develop the AIE-ESD model as an attempt at conceptual synthesis that connects the three domains. Thus, the table serves not only as a summary of the literature, but also as conceptual empirical evidence that reinforces the urgency of integration in the development of sustainability-based learning.

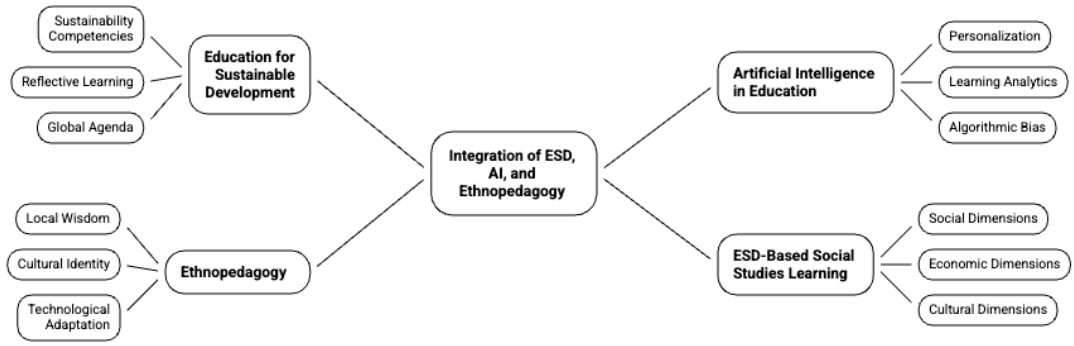

Figure 1. Integrated of ESD, AI, and Ethnopedagogy in Education

3.3 Thematic Integration: Towards a Holistic Model

Based on the results of the literature synthesis analysis, it can be emphasized that strengthening Education for Sustainable Development (ESD) in the context of social studies learning requires simultaneous integration of three main dimensions, namely normative, technological, and cultural dimensions. The normative dimension represented by ESD serves as a conceptual foundation that provides direction, goals, and value orientation in the educational process. ESD not only emphasizes the achievement of cognitive learning outcomes, but also encourages the formation of critical awareness, social responsibility, and commitment to environmental sustainability and human life at large [1], [20]. Thus, this dimension becomes the main framework that directs the entire learning process to be in harmony with the principles of sustainable development.

Furthermore, the technological dimension realized through the integration of artificial intelligence plays a role as an innovative instrument that is able to transform the learning process to be more adaptive, personalized, and data-based. The use of AI in education allows the development of learning systems that are responsive to the individual needs of students, such as through adaptive learning, learning analytics, and educational chatbots [5], [6]. However, without a clear normative direction, the use of technology risks being trapped in a mere efficiency orientation and ignoring the value dimension, so its integration with the ESD framework becomes crucial.

On the other hand, the cultural dimension represented by the ethnopedagogical approach provides a learning context rooted in the values of local wisdom. Ethnopedagogy allows the learning process to be more relevant, meaningful, and contextual to the lives of learners, as it integrates social and cultural practices that have lived in society [23], [25]. In the context of Indonesia, especially Madura, values such as social solidarity, mutual cooperation, and wisdom in local resource

management are tangible representations of sustainability principles that can be internalized through social studies learning.

The three dimensions basically have complementary roles, but in practice they often develop partially and separately. Educational approaches that focus only on one dimension tend to produce a learning process that is not complete and is less able to respond to the complexity of multidimensional global challenges. Therefore, the integration between normative (ESD), technological (AI), and cultural (ethnopedagogical) dimensions is an urgent need in the development of future learning models. This integration not only strengthens the quality of learning pedagogically, but also contributes to forming students who have sustainability competencies that are intact, adaptive, and rooted in the local context while being responsive to global dynamics.

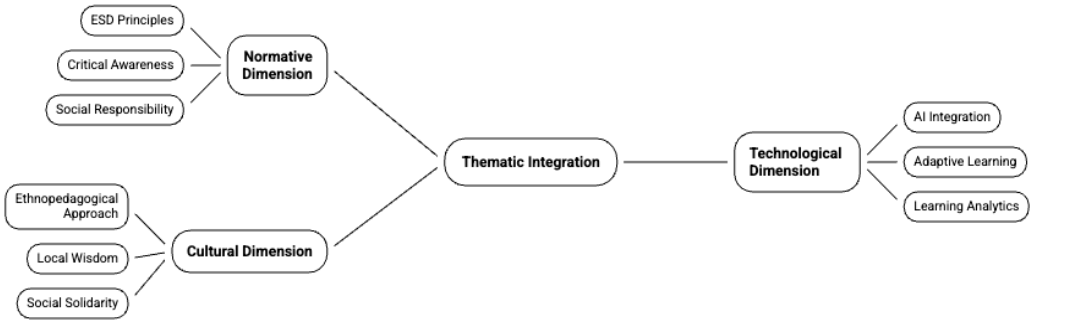

Figure 2. Thematic Integration for Holistic ESD Learning

4. Discussion

4.1 Reinterpretation of the AIE-ESD Model

The AI–Ethnopedagogy Integrated ESD Learning Model (AIE-ESD) developed in this study can be positioned as a form of learning paradigm reconstruction that seeks to bridge the tension between technological modernity and cultural roots in the framework of sustainability. This model not only combines the three main elements of ESD, artificial intelligence, and ethnopedagogy but also reconceptualizes the relationship between the three in an integrative and transformative learning system. In this context, ESD serves as a normative orientation, while artificial intelligence and ethnopedagogy act as complementary instruments and contexts in achieving the goals of continuous learning [5], [20].

In this model, artificial intelligence is no longer understood narrowly as a technical aid oriented towards learning efficiency, but as a pedagogical facilitator that allows for an adaptive, reflective, and dialogical learning process. The use of technologies such as AI-based chatbots, for example, can be designed not only to provide information, but also to spark critical discussions, ask reflective questions, and connect global issues such as climate change or social inequality with local realities that are close to learners' experiences. This approach is in line with the view that technology in education should not be neutral, but should be geared towards supporting normative goals of education, including sustainability [6], [7].

On the other hand, ethnopedagogy in the AIE-ESD model functions as an epistemological balancer that keeps the learning process inseparable from the social and cultural context of students. Ethnopedagogy allows the internalization of local values that have been proven to be adaptive in maintaining the sustainability of people's lives. In the context of Madura, values such as social solidarity (taretan dhibi'), mutual cooperation, and wisdom in local resource management not only have a cultural dimension, but also reflect sustainability principles that are relevant to the global agenda. The integration of these values into social studies learning allows students to relate abstract concepts of sustainability with real practices in daily life, so that the learning process becomes more meaningful and contextual [23], [25].

Furthermore, from the perspective of social studies learning, the AIE-ESD model makes a significant contribution in transforming the learning function from mere knowledge transfer to the formation of critical and reflective social awareness. Social studies is no longer positioned as a purely informative subject, but as a strategic pedagogical space to integrate global issues, technological innovations, and local values in one holistic learning framework. Through this approach, students not only understand social dynamics conceptually, but are also able to develop a critical perspective on various sustainability issues faced by society.

Thus, the reinterpretation of the AIE-ESD model emphasizes that integration between technology, culture, and sustainability is not just a pedagogical choice, but a necessity in facing the complexity of educational challenges in the global era. This model offers a new approach that is not only adaptive to technological developments, but also remains rooted in local values, thus being able to produce a more contextual, reflective and sustainability-oriented learning process.

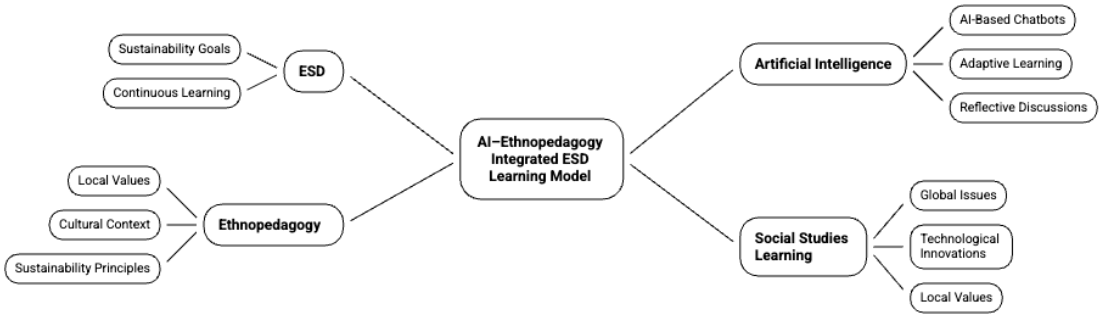

Figure 3. AI-Ethnopedagogy Integrated ESD Learning Model

4.2 Theoretical and Practical Implications

Theoretically, this research makes a significant contribution through the development of a conceptual model that integrates the three main domains of Education for Sustainable Development (ESD), artificial intelligence, and ethnopedagogy that have tended to develop separately in the educational literature. The proposed AIE-ESD model not only connects the three domains structurally, but also reconstructs the functional relationships between the three in a single coherent and systemic learning framework. By placing ESD as a normative foundation, artificial intelligence as an instrument of pedagogical transformation, and ethnopedagogy as a contextual basis, this model expands the scope of sustainability-based learning theory from being normative to more operational and applicative. This is in line with the need to develop contemporary educational theories that not only explain phenomena, but also be able to offer an integrative framework that is adaptive to global and local dynamics [15], [20].

Furthermore, this model also contributes to enriching the discourse on the use of artificial intelligence in education by placing it in a critical and humanistic perspective. In contrast to the dominant approach that tends to be technocentric, this study confirms that the integration of AI in learning should be directed by sustainability values and cultural context, so as to not only increase efficiency, but also strengthen the meaning and relevance of learning [6], [7]. Thus, theoretically, this research opens up space for the development of a new paradigm in educational studies, namely an integrative paradigm that combines the dimensions of technology, culture, and sustainability simultaneously.

In practical terms, the AIE-ESD model and its applications to curriculum design and pedagogical practice in the classroom also offer valuable lessons from its findings, especially in social studies learning. First, at the curriculum level, the results of this research can be the basis for designing an ESD-based curriculum that integrates global issues in one's teaching plan and does so with local wisdom as part of the teaching material. Second, at the learning design level, the integration of artificial intelligence brings a more personalized and adaptive learning experience. For example, educational chatbots designed to facilitate contextual discussions based on sustainability issues are used. Third, at the pedagogical practice level, ethnopedagogical methods may be implemented to encourage students' involvement by placing the learning subjects within the social and cultural context in which they live. Moreover, from the perspective of education in Indonesia, more specifically in areas such as Madura, this model might be strategically useful in that it provides a bridge between the modernization of education and the preservation of local cultural values. The integration of technology with local wisdom, therefore, allows the learning process to be dynamic and applicable, and connected to the regional cultural identity. Thus, the practical implications of this study are not limited to enhancing the quality of learning. It also contributes more broadly to strengthening social and cultural resilience as part of national resilience.

4.3 Research Implications

Theoretically, this research contributes to the development of a more comprehensive sustainability-based learning paradigm by integrating normative, technological, and cultural dimensions in one complete conceptual framework. The AIE-ESD model expands the scope of ESD

theory, which has tended to be normative to be more operational and contextual, as well as enriching the study of the use of artificial intelligence in education with a more humanistic and value-based perspective.

In practice, this study indicates the need for ESD-oriented social studies learning to incorporate artificial intelligence both as a component of an adaptive and reflective learning design as well as for stronger ethnopedagogical practices based on local wisdom values to improve students' contextual understanding and engagement in ESD-based social studies learning. This integrative model needs teachers with strong pedagogical and digital competencies to apply it. The proposed AIE-ESD model has strategic implications for enhancing national resilience, as it establishes education as a platform for sustainable social transformation that is adaptive to global technological change while preserving cultural identity and social cohesion.

4.4 Limitations and Recommendations for Advanced Research

This study is restricted by being conceptual without any empirical testing in real classroom contexts. Hence, it is advised that future research empirically investigate the efficacy of the AIE-ESD model via quantitative, qualitative, and design-based research methods, mainly for improving students' sustainability competencies. Future research is also required to develop comprehensive evaluation instruments capable of measuring the integration of artificial intelligence, ethnopedagogy, and ESD within learning processes, as well as to explore the implementation of the model across diverse cultural contexts in Indonesia to strengthen and expand ethnopedagogical perspectives in sustainable education.

5. Conclusion

This study shows that to enhance ESD in social studies education demands sustainability values, artificial intelligence, and ethnopedagogy. The results indicate that ESD can build the normative framework, artificial intelligence can foster adaptive and individualized learning, and ethnopedagogy can provide cultural and contextual relevance. Up until this stage, studies have explored these dimensions of study on their own which is largely less integrated conceptually. So as to bridge this gap, the study suggests that the AI–Ethnopedagogy Integrated ESD (AIE-ESD) Model be adopted as the overarching framework for incorporating technology and local knowledge in the practice of sustainability-focused social studies education. The importance of the study is that it supports the development of a technology- and culture-responsive learning that can enhance students' sustainability skills, critical thought, and national resilience. The study also provides a theoretical foundation for future sustainability-based educational innovation in multicultural environments. Future research is suggested to explore empirically how the AIE-ESD model would prove and be used in different types of teaching environments, and also in digital learning ecosystems.

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