

BRIDGING TECHNOLOGY AND HUMANITY: THE CHALLENGES OF INTEGRATING ARTIFICIAL INTELLIGENCE AND DEEP LEARNING IN CHARACTER EDUCATION AT ELEMENTARY SCHOOL

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Abstract

The development of artificial intelligence and deep learning has created new opportunities for learning innovation in elementary schools. However, behind this progress lies a challenge in maintaining a balance between the use of technology and the cultivation of students' character. This study aims to explore the challenges and obstacles in integrating AI and deep learning into character education, as well as to examine the role of teachers in bridging technological aspects and human values. The research employs a descriptive qualitative approach, with data collected through surveys and interviews with elementary school teachers to uncover their perceptions, experiences, and strategies in adapting to digital learning transformations. The findings reveal that limited digital literacy, inadequate infrastructure, and the absence of ethical guidelines are major barriers to the implementation of learning technologies. Nevertheless, teachers perceive AI as having the potential to strengthen reflective and values-based learning when applied through a humanistic approach. The implications of this study highlight the importance of synergy among educators, technology developers, and policymakers in creating a learning ecosystem that balances digital advancement with the reinforcement of human character.

Keywords: *Artificial intelligence, Deep learning, Character building, Humanization of Technology*

INTRODUCTION

The digital transformation in education is accelerating rapidly, marked by the growing adoption of artificial intelligence and deep learning technologies in the learning process. These technologies offer significant opportunities to enhance learning personalization, improve assessment effectiveness, and enable teachers to better understand each student's unique needs. However, amid this progress, concerns have emerged that the human dimension particularly moral values and character may become marginalized if education relies too heavily on algorithm-based systems. This condition underscores the importance of efforts to bridge technological sophistication with human values in the context of elementary education.

The focus on character education in Indonesia has grown stronger since the enactment of Presidential Regulation No. 87 of 2017 on Strengthening Character Education. Various previous studies have emphasized the importance of internalizing values such as religiosity,

discipline, responsibility, and social awareness through conventional approaches. For example, Wahida Suaiba Lubis (2024) highlights the importance of implementing Pancasila values in civic education (PKn) to shape citizens with strong character and a democratic spirit, while Kinanti & Wicaksono (2021) demonstrate the effectiveness of character education based on local wisdom in developing students who are faithful, creative, and responsible. Furthermore, Kartika & Jannah (2025) found that prophetic values such as tolerance and love for peace can be internalized through the animated film Riko The Series, aligning with Moh. Roqib's vision of prophetic character education. Nevertheless, these approaches remain largely manual and traditional, lacking an in-depth exploration of how intelligent technologies such as AI and deep learning can be integrated into more dynamic and contextual character education.

Recent phenomena reveal an imbalance between the rapid adoption of digital technology and the internalization of human values. Schools have begun using learning management systems, adaptive learning applications, and AI-based interactive media. However, various field studies indicate a decline in empathy, social responsibility, and discipline among elementary school students. Teachers also face a dilemma between the demand for digital innovation and their role as moral exemplars. Ethical and pedagogical challenges arise when AI systems are used to assess behavior or provide emotional feedback, as algorithms are not yet fully capable of understanding the context of values, empathy, and morality in children. This condition highlights a gap between technological advancements in education and the development of character grounded in Pancasila values and universal humanism.

Several previous studies have emphasized the importance of character education in shaping morally grounded and competitive generations; however, most remain focused on conventional, religious, or cultural approaches. Taman Firdaus (2021) highlights the importance of utilizing online multimedia to cultivate humanistic and character-driven educators, yet this remains limited to the use of basic digital technologies rather than adaptive AI-based intelligent systems. Similarly, Ithnin et al., (2023) underscore the significance of spiritual and moral values in character education through the integration of Hadith teachings, but they have not yet linked these concepts to algorithmic or ethical technology approaches.

Other studies, such as those conducted by Iman Hidayat, M Hosnan (2021); Indraswari et al., (2024); Nurdin, (2020) emphasize the importance of the learning environment, extracurricular activities, and teacher competence in character formation. Nevertheless, these studies have not yet considered the potential of AI as a reflective tool to support the adaptive learning of values and morals. Only the study by Marini et al., (2021) has begun to apply mobile web-based character building; however, this technology remains limited to simple web-based applications and has not yet utilized deep learning capable of contextually understanding the dynamics of students' character behavior.

This condition reveals a research gap namely, the absence of in depth qualitative studies on how artificial intelligence and deep learning can be ethically and pedagogically integrated into character education in elementary schools. Previous studies have indeed discussed aspects of morality, values, and the role of teachers, but none have systematically bridged technology and humanity within a unified conceptual framework. Therefore, this study aims to analyze the obstacles, challenges, and opportunities in integrating AI and deep learning into character

education to create synergy between technological advancement and human values within the context of Indonesian elementary education.

This study aims to identify the obstacles and challenges in implementing AI and deep learning in character education, while also analyzing ethical and pedagogical opportunities and strategies to bridge technology with human values. Through a qualitative approach, the research seeks to formulate a conceptual model for AI integration that goes beyond mere learning efficiency and supports the development of students' character without diminishing the moral, spiritual, and emotional dimensions of the teaching and learning process.

Theoretically, this study contributes to the development of technology-based character education theory by expanding the Technological Pedagogical and Content Knowledge (TPACK) framework into an Ethical-AI Pedagogical Integration Model, which emphasizes the balance between digital intelligence and moral intelligence Celik, (2023); Gómez-Trigueros, (2023). Practically, the findings of this study are expected to provide guidance for elementary school teachers in applying AI through a humanistic approach, ensuring that technology functions not only as a supporting tool but also as a reflective medium to foster empathy, responsibility, and collaboration among students.

The main novelty of this study lies in its explicit focus on the use of AI and deep learning techniques within the context of character education in elementary schools—a field that remains underexplored both nationally and globally. This research adopts a human-centered AI approach to explore the perceptions of teachers, students, and policymakers regarding the balance between technological advancement and human values kemanusiaan Riedl, (2019); Shneiderman & Plaisant, (2020); Sigfrids et al., (2023). The findings are expected to produce a new conceptual model called the Bridging Technology and Values Framework, which offers ethical and pedagogical guidelines for implementing AI in Indonesian elementary education Boshuijzen-van Burken, (2023); Hendry et al., (2021); Shneiderman (2020).

Preliminary findings indicate that the integration of AI holds significant potential to strengthen character education when directed toward the personalization of moral learning—for instance, through the analysis of student reflections, empathy-based deep learning simulations, and teacher training on the ethical use of AI. However, without adequate regulation and ethical competence, the use of such technology risks undermining the humanistic dimension of education. Therefore, this study recommends the development of an AI-based digital ethics and character curriculum, the enhancement of teachers' algorithmic literacy and ethics, and the formulation of national guidelines for integrating AI into character education that align with the Profil Pelajar Pancasila and universal humanistic principles.

The scope of this study includes a qualitative analysis of character education practices in Indonesian elementary schools, focusing on teachers' and students' perceptions of the use of AI and deep learning in the context of value-based learning. This research does not focus on the technical development of AI systems but rather on the meaningful integration between technology and character formation as an effort to maintain a balance between digital innovation and humanity in education.

LITERATURE REVIEW

The integration of artificial intelligence (AI) and deep learning in education has become a major focus in various global studies. Tedre et al., (2021) explain that the implementation of machine learning (ML) and AI at the elementary level still faces several pedagogical challenges; however, it is crucial to introduce them early to foster ethical literacy and technological awareness among students. In line with this, Rane, (2025) emphasizes that education in the era of Education 4.0 and 5.0 positions AI not merely as a tool for automation but as a collaborative partner (augmented intelligence) that supports personalized learning while fostering human character development, such as empathy, responsibility, and creativity.

Research by Somasundaram et al., (2020) identifies that the application of AI can assist in designing curricula tailored to students' learning needs, making the learning process more adaptive and efficient. However, Anton Napitupulu reminds us that technological advancements in education should not displace spiritual and human values, as the true purpose of education is to shape the whole person, not merely individuals who are cognitively intelligent. In the context of character education, Rosita & Tamimi, (2024) emphasize the importance of moral guidance from teachers and parents when students interact with AI-based technologies, ensuring that moral and ethical values remain consistently internalized in their daily lives.

Dina Atika Hesti highlights the need for teacher training and the development of an AI ethics curriculum to ensure the wise use of technology, while Amalia Agustina and Yaya Suharya view AI as a means to accelerate the realization of the Golden Generation 2045 by positioning teachers as moral guides and value facilitators. Studies by Nurhakim, (2025); Rindaningsih et al., (2024) show that the readiness of digital infrastructure and teacher competence are key factors determining the success of AI integration in elementary schools. Meanwhile, Jiang, (2022); Yong Cao, (2024) demonstrate that deep learning is effective in enhancing student engagement and strengthening meaningful learning. Furthermore, research by Lefaan Adolina Velomena, Dhanu Priyo Widodo, (2025); as well as Madeamin (2025), reveals that character-based deep learning applications can foster students' moral reflection, responsibility, and social values.

In the local context, studies by Marini et al., (2021); Rizqi & Maknun, (2021); Taman Firdaus, (2021) affirm that character education based on Pancasila values, local wisdom, and digital technology fosters learning that is more contextual, humanistic, and ethical. The overall findings indicate that the integration of AI and deep learning in elementary schools is not only related to technological aspects but is also closely connected to ethical and character dimensions, which form the core of humanity in education.

Theoretically, this study is grounded in constructivist theory developed by Jean Piaget and Lev Vygotsky. This theory posits that knowledge is actively constructed by learners through interaction with their environment and social experiences Permana et al., (2025) In the context of AI and deep learning-based education, teachers function as facilitators who help students construct understanding through collaborative and reflective digital learning experiences. This foundation is further reinforced by the New Pedagogies for Deep Learning approach proposed by Michael Fullan and Maria Langworthy, which emphasizes the importance of mastering 21st-century skills, including critical thinking, communication, collaboration, creativity, and character formation. Through the use of AI, learning can be

designed to become more personalized, in-depth, and relevant to students' real-life contexts Almeida & Rosero, (2021); Apriliyana, (2025); Mthethwa-Kunene et al., (2021); Mundofi, (2025).

In addition, the character education theories of Thomas Lickona and Lawrence Kohlberg serve as important moral foundations for this study. Lickona emphasizes the importance of character development through the cultivation of universal moral values, while Kohlberg highlights the stages of moral development that focus on learners' ethical reasoning abilities. Within this framework, the integration of AI and deep learning must continue to uphold the values of empathy, responsibility, and ethics to ensure that technology does not displace the humanistic dimension of education (Mainuddin et al., 2023; Permana et al., 2025).

The conceptual framework of this study also refers to Education 4.0 and 5.0 theories proposed by Joseph E. Aoun and Yoshiharu Kawamura. Aoun introduced the concept of robot-proof education, which prepares humans to remain competitive amid the rise of automation by emphasizing cognitive, interpersonal, and character competencies. Kawamura, through the idea of Society 5.0, underscores the importance of harmony between technology and humanity, positioning AI as a tool to enhance human well-being rather than replace it (Akturk et al., 2022; Mytra et al., 2021).

The integration of AI and deep learning in elementary schools must be directed toward achieving a balance between technological proficiency and character development. Based on constructivist theory, students need to build knowledge through meaningful learning experiences under the guidance of teachers. The New Pedagogies for Deep Learning approach provides space for the use of AI to deepen the learning process, while the character education theories of Lickona and Kohlberg ensure that moral and ethical dimensions remain central in digital learning. From the perspectives of Education 4.0 and 5.0, as proposed by Aoun and Kawamura, technology is expected to strengthen human qualities that are critical, creative, ethical, and collaborative. The implementation of AI and deep learning in elementary education should therefore aim to develop students who are not only digitally competent but also virtuous, empathetic, and adaptive to the changing times.

RESEARCH METHOD

This study employs a descriptive qualitative method aimed at providing an in-depth description of the perceptions, experiences, and challenges faced by elementary school teachers in integrating artificial intelligence (AI) and deep learning into character-based learning. The qualitative approach was chosen because it allows researchers to understand phenomena holistically and contextually through the direct experiences of participants in real-world settings (Creswell, 2018). Thus, this research does not focus on statistical measurement but rather on the subjective interpretation of the processes and dynamics involved in the implementation of technology within the context of character education.

The research was conducted in Songgom District, Brebes Regency, which consists of twelve elementary schools with a total of thirty-six teachers participating in the study. This location was selected based on the consideration that the area is currently in a transitional phase toward digital learning but still faces challenges related to human resource readiness, technological infrastructure, and teachers' digital literacy. The research participants were

intentionally selected using a purposive sampling technique, taking into account specific criteria namely, teachers who are familiar with or have begun to implement AI and deep learning-based technologies in their teaching activities (Assyakurrohim et al., 2022; Nyimbili, 2024).

The data sources in this study include both primary and secondary data. Primary data were obtained through open-ended surveys and in-depth interviews with teachers, while secondary data were collected from various sources such as school curriculum documents, educational regulations, and scholarly literature related to AI integration and character education. Data collection was carried out through surveys aimed at exploring teachers' general perspectives on the potential and challenges of AI implementation. In addition, a documentation study was conducted to examine the extent to which policies and learning tools support character development through digital technology (Ultavia et al., 2023).

The data were analyzed using the thematic analysis approach proposed by Braun and Clarke (2006), beginning with a thorough reading of all collected data. The analysis process started with a careful examination of the data to identify underlying meanings, followed by open coding to discover key themes related to the challenges, barriers, and strategies employed by teachers in integrating AI and deep learning into character education. Once the themes were established, the researcher interpreted the interconnections among them to construct an in-depth narrative of the phenomenon under study (Nurhaliza et al., 2025).

To ensure data validity, this study employed source and method triangulation techniques by comparing information obtained from surveys, interviews, and school documents to verify data consistency. Data validity was further strengthened through member checking, a process in which research findings were confirmed by participants to ensure that the researcher's interpretations accurately reflected their real experiences (Lincoln & Guba, 1985). Through these measures, the reliability and credibility of the research were maintained (Enworo, 2023; Kakar et al., 2023; Nurhaliza et al., 2025).

The research was conducted through three main stages. The initial stage involved preparation activities, including the design of research instruments such as open-ended questionnaires and interview guidelines, as well as obtaining research permits from the schools. The second stage was the implementation phase, which consisted of data collection in the field through surveys and interviews with teachers from twelve elementary schools in Songgom District. The final stage was analysis and reporting, which included data processing, interpretation of findings, and the preparation of a research report in a descriptive thematic format. Through this descriptive qualitative approach, the study is expected to provide an in-depth understanding of the realities of implementing AI and deep learning in character education at the elementary school level, as well as offer a conceptual contribution to the development of educational policies that are humanistic and adaptive to technological advancements.

RESULTS AND DISCUSSION

Based on the survey results involving thirty teachers from twelve elementary schools in Songgom District, various perspectives were obtained that reflect the challenges and obstacles in implementing AI based learning, deep learning, and character education. Thematic

analysis of the data revealed three dominant themes: limited technological resources, low levels of teachers' digital literacy, and challenges in integrating character values into digital learning.

The first and most frequently emerging theme is the limitation of technology and educational infrastructure, as expressed by approximately 53.3% of teachers. The respondents explained that most elementary schools in Songgom District still lack adequate digital facilities to support the implementation of AI based learning both in terms of hardware, such as computers and internet networks, and software that facilitates interactive learning processes. Some teachers also added that limited school budgets and insufficient technical support have resulted in AI implementation remaining at the level of discourse or limited simulation. This finding aligns with the studies of Lukman Nurhakim (2022) dan Ida Rindaningsih (2023), which emphasize that the readiness of digital infrastructure is a determining factor in the successful integration of AI in elementary school settings. Thus, the greatest challenge lies not in the idea of implementation itself, but in the readiness of facilities and supporting policies at the school level.

The second theme is pedagogical challenges and the low level of teachers' digital literacy, as reported by approximately 63.3% of respondents. The teachers admitted that they do not yet fully understand the basic concepts of AI and deep learning and find it difficult to adapt technology-based learning models to the characteristics of elementary school students, who still require concrete and contextual learning approaches. Many teachers stated that materials related to programming or AI introduction feel too complex for young learners. In addition, some teachers acknowledged that they are not yet accustomed to using AI-based applications in the learning process due to the lack of training and technical guidance. This condition supports the view of Tedre et al., (2021) who stated that the implementation of machine learning in primary education still faces significant pedagogical challenges, as well as the findings of Hesti et al., (2025), which emphasize the importance of professional training for teachers to enhance digital literacy and ethical technology use in education.

The third theme that emerged from this study is the challenge of integrating character values into technology-based learning, as expressed by approximately 30% of teachers. Most respondents emphasized that the use of AI in education has the potential to reduce social interaction and emotional closeness between teachers and students if it is not balanced with a humanistic approach. The teachers believed that character education such as empathy, honesty, and responsibility requires direct interpersonal interaction rather than being solely mediated through digital screens. This concern aligns with the perspective of Rosita & Tamimi, (2024), who highlight the importance of moral guidance from teachers and parents when students engage with technology, ensuring that moral values are not overshadowed by technological efficiency. In the context of character education theory, Thomas Lickona (1991) and Lawrence Kohlberg (1981) also assert that moral character formation must occur through role modeling, habituation, and continuous value reflection (Mainuddin et al., 2023; Permana et al., 2025).

Interestingly, despite facing various challenges, some teachers in this study expressed optimism about the positive potential of AI and deep learning in supporting character-based learning. They believed that technology can be used constructively to foster values such as responsibility, discipline, and creativity when developed within a guided and value-oriented learning context. This perspective aligns with the New Pedagogies for Deep Learning approach

proposed by Fullan and Langworthy (2014), which views AI not merely as a learning tool but also as a means to deepen learning experiences through collaboration, reflection, and meaningful engagement (Fullan et al., 2018; Talaei Khoei et al., 2023; Weng et al., 2023).

The results of the study show that the implementation of AI and deep learning in elementary education requires synergy between technological, pedagogical, and value-based aspects. From the perspective of Piaget's and Vygotsky's constructivist theories, teachers continue to play a central role as facilitators in helping students construct knowledge through meaningful digital experiences and active social interaction. In the context of Education 4.0 and 5.0, as proposed by Aoun (2017) and Kawamura (2020), technology should serve as a means to strengthen humanity, not to replace it (Ahmad et al., 2023; Mytra et al., 2021; Rane, 2025).

Thus, the findings of this study reveal that the integration of AI and deep learning in character education activities at the elementary school level should be directed toward achieving a balance between technological mastery and the reinforcement of moral values. Teachers need to be supported through training and policies that promote ethical digital literacy, while schools should foster a learning culture that harmonizes technological advancement with humanity. Character-oriented integration of AI and deep learning not only produces students with digital intelligence but also individuals who are virtuous, empathetic, and adaptable to the changes of the automation era.

CONCLUSION

This study concludes that the integration of artificial intelligence and deep learning in character education at elementary schools in Songgom District faces three main challenges: limited technological infrastructure, low levels of teachers' digital literacy, and the difficulty of maintaining a balance between technological advancement and students' character development. These obstacles have hindered the optimal implementation of AI-based learning, although some teachers have demonstrated strong awareness and commitment to the importance of character education in the digital era.

These findings are consistent with Piaget's and Vygotsky's constructivist theories, which emphasize that the learning process is built through active interaction between students and their environment, guided by the teacher as a facilitator. In the context of AI-based learning, the teacher's role remains central in helping students construct meaning and values. The results of this study also support the New Pedagogies for Deep Learning approach (Fullan & Langworthy), which highlights the importance of collaboration, creativity, and character values in meaningful learning. Furthermore, the concept of character education introduced by Lickona and Kohlberg reinforces the idea that quality education should foster moral awareness and ethical responsibility, not merely intellectual intelligence. Within the framework of Education 4.0 and 5.0 (Aoun & Kawamura), these findings affirm that technology should serve to strengthen human values rather than replace them.

Theoretically, this study reinforces the view that AI and deep learning can serve as tools for constructivist and humanistic learning that expand learning experiences without diminishing the moral values within them. Practically, the findings highlight the importance of improving teachers' digital literacy competencies and ensuring infrastructure readiness before

implementing AI-based learning systems in elementary schools. Moreover, the integration of technology should be directed to align with the goals of character education, so that students not only master cognitive aspects but also grow into ethical, creative, and empathetic individuals.

This study recommends that the government and educational institutions enhance teacher training in digital literacy, technology ethics, and AI-based instructional design. Schools need to develop internal policies that balance technological advancement with the reinforcement of human values. Meanwhile, future research is advised to adopt a mixed-methods approach to obtain a more comprehensive understanding of the impact of AI on character formation, both from the cognitive and emotional perspectives of students.

Overall, the findings of this study align with constructivist theory, character education, as well as the paradigms of New Pedagogies for Deep Learning and Education 5.0. The integration of AI and deep learning not only enriches existing educational theories but also opens new opportunities for more meaningful and character-oriented learning. When applied with the right approach, technology has the potential to become a tool for nurturing a generation that is digitally intelligent, morally grounded, and adaptable to changes in the era of automation.

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