Program Studi Pendidikan Guru Madrasah Ibtidaiyah
Fakultas Ilmu Tarbiyah dan Keguruan
UIN Raden Fatah Palembang
Indonesia
p-ISSN: 2527-2764
e-ISSN: 2527-4589
JIP (Jurnal Ilmiah PGMI)

The Implementation of Deep Learning as an Effort to Realize Transformative Education in Elementary School

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Abstract

Twenty-first century education demands learning approaches that cultivate students' critical, reflective, and adaptive thinking skills to respond to rapid changes in society. Although deep learning has been widely promoted as a strategy to support transformative education, many elementary schools in Indonesia still rely on conventional, teacher-centered methods, leading to limited student engagement, shallow understanding, and minimal opportunities for reflection and inquiry. This gap between the expected transformative learning practices and the realities of classroom implementation provides an opportunity to investigate how deep learning can be applied effectively at the primary level. This study aimed to explore the implementation of a deep learning system in elementary education and examine its contribution to realizing transformative learning. The research employed a qualitative descriptive design with data collected through interviews, observations, and documentation at SD Negeri 46 Pagaralam, South Sumatra Province. The participants consisted of teachers and students directly involved in deep learning practices. The findings show that deep learning was implemented through five strategies. These strategies foster active engagement, higher-order thinking, and the development of human values such as empathy, ethics, and social responsibility. The study concludes that deep learning not only enhances the quality of the learning process but also contributes significantly to students' cognitive and character transformation. The implications highlight the importance of teacher training, flexible curriculum, and technological support to sustain deep learning implementation in elementary schools.

Keywords: Deep Learning, Transformative Education, Elementary School, Student Engagement, 21st-Century Learning

Abstrak

Pendidikan abad ke-21 menuntut pendekatan pembelajaran yang menumbuhkan keterampilan berpikir kritis, reflektif, dan adaptif siswa untuk menanggapi perubahan cepat dalam masyarakat. Meskipun pembelajaran mendalam telah dipromosikan secara luas sebagai strategi untuk mendukung pendidikan transformatif, banyak sekolah dasar di Indonesia masih mengandalkan metode konvensional yang berpusat pada guru, yang menyebabkan keterlibatan siswa yang terbatas, pemahaman yang dangkal, dan minimnya kesempatan untuk refleksi dan penyelidikan. Kesenjangan antara praktik pembelajaran transformatif yang diharapkan dan realitas implementasi di kelas memberikan kesempatan untuk menyelidiki bagaimana pembelajaran mendalam dapat diterapkan

Volume 11 No. 2, December 2025
DOI: https://doi.org/10.19109/jip.v11i2.30386

secara efektif di tingkat sekolah dasar. Studi ini bertujuan untuk mengeksplorasi implementasi sistem pembelajaran mendalam di pendidikan dasar dan meneliti kontribusinya dalam mewujudkan pembelajaran transformatif. Penelitian ini menggunakan desain deskriptif kualitatif dengan data yang dikumpulkan melalui wawancara, observasi, dan dokumentasi di SD Negeri 46 Pagaralam, Provinsi Sumatera Selatan. Partisipan terdiri dari guru dan siswa yang terlibat langsung dalam praktik pembelajaran mendalam. Temuan menunjukkan bahwa pembelajaran mendalam diimplementasikan melalui lima strategi. Strategi-strategi ini mendorong keterlibatan aktif, berpikir tingkat tinggi, dan pengembangan nilai-nilai kemanusiaan seperti empati, etika, dan tanggung jawab sosial. Studi ini menyimpulkan bahwa pembelajaran mendalam tidak hanya meningkatkan kualitas proses pembelajaran tetapi juga memberikan kontribusi signifikan terhadap transformasi kognitif dan karakter siswa. Implikasinya menyoroti pentingnya pelatihan guru, kurikulum yang fleksibel, dan dukungan teknologi untuk mempertahankan implementasi pembelajaran mendalam di sekolah dasar.

Kata kunci: *Pembelajaran Mendalam, Pendidikan Transformatif, Sekolah Dasar, Keterlibatan Siswa, Pembelajaran Abad ke-21*

INTRODUCTION

Education in Indonesia is currently undergoing reforms to meet the demands of the 21st century, where critical analysis skills, innovation, and the ability to work together are increasingly crucial parts of education. (Muthmainnah, Cardoso, Marzuki, & Al Yakin, 2025). In the era of the industrial revolution 4.0 and the rapid development of information technology, the challenges of the world of education are increasingly complex, guiding a paradigm shift in the learning process (Yeh dkk., 2024). At the elementary school level, the learning process is no longer sufficient if it merely focuses on delivering content; it must also be oriented toward developing critical and creative thinking skills, collaborative abilities, and effective communication (Al-Kamzari & Alias, 2025). This approach aligns with the principles of transformative education, which aim to develop critical awareness and encourage changes in students' perspectives in understanding the realities around them (Rochmat, 2018).

Nevertheless, learning practices at the elementary level are still dominated by conventional methods such as one-way lectures and rigid curriculum implementation. This results in a lack of personalized learning, even though each student has a unique learning style (Chen et al., 2020). This condition presents challenges for teachers in accommodating diverse student learning styles and creating meaningful learning experiences. Previous studies (Singh & Miah, 2020) emphasize that transformative education requires pedagogical approaches capable of empowering students to think critically, creatively, and adaptively in response to change, as well as shaping them into individuals who can contribute positively to society (Dhamija & Dhamija, 2025). However, research exploring learning models that specifically support these goals at the elementary school level remains limited.

One approach that has been developed to support this goal is deep learning (Sliwka, Klopsch, Beigel, & Tung, 2024). In the context of education, deep learning does not simply refer to artificial intelligence technology but refers to deep learning strategies that focus on conceptual understanding, reflection, and integration of knowledge in real life (Lee, Ham, Kim, & Park, 2025). Through this learning system, students not only memorize information but are also able to analyze, evaluate, and create new knowledge from what they learn.

Deep learning is one of the innovations in education where students learn deeply. The development of learning can create wider learning opportunities (Guo, Li, & Guo, 2021) as well as provide adaptive materials according to individual needs. The utilization of deep learning creates a more dynamic learning environment that is not bound by space, so that learning becomes more relevant to real life.

This deep learning approach has three main pillars, namely mindful learning, meaningful learning, and joyful learning (Kurniawan, 2025). Mindful learning is a learning process that is done with full awareness, focus, and student engagement (Schonert-Reichl & Roeser, 2016). Meaningful

learning is the collaboration of material with prior knowledge and problems that are relevant to students' lives (Mayer, 2010). While joyful learning is the creation of a positive, interesting, and motivating learning environment for students to engage in the learning process with enthusiasm (Müller & Mildenberger, 2021).

In several pieces of literature, the term "deep learning" is also used in the context of artificial intelligence (AI) technology. Deep learning as a pedagogical approach focuses on reflective and meaningful human learning processes, whereas deep learning in AI refers to computational algorithms that enable machines to learn from data (Dashti et al., 2025). Integrating technology into education serves as a supportive tool for knowledge development, thereby contributing to new advancements in the educational field (Dalisaymo, 2025). Therefore, this study positions AI technology as a supporting medium in the implementation of deep learning, rather than as the primary focus.

This deep learning model can be integrated into various forms of technology-based learning that support active and collaborative learning. Online learning applications become a very useful medium in providing deep and relevant learning experiences and increasing students' involvement in the learning process. Deep learning serves as the basis in realizing transformative education, which focuses on changing the way learners think, critical awareness of the environment, and active involvement in social change (Lee et al., 2025).

The application of deep learning in the context of basic education has been the focus of many studies highlighting its role in promoting transformative education. Zebua (2025) revealed that deep learning encourages students' active engagement in meaningful and reflective learning and supports the development of 21st-century skills such as critical thinking, creativity, and collaboration holistically. Meanwhile, Hans et al. (2022) suggests that deep learning strategies improve teachers' instructional design skills and are drivers of change. Furthermore (Wibawa, Dwiyanto, & Utama, 2022) revealed that deep learning has a transformative impact and is increasingly being applied in various educational contexts, including at the primary school level, thus encouraging further research in this field.

These studies identify that the implementation of deep learning in basic education can support the creation of a more transformative education. However, there are still challenges, such as teacher readiness, limited facilities, and a curriculum that has not fully supported transformative learning. This study seeks to address these gaps by exploring the implementation of a deep learning–based instructional system in elementary schools and its contribution to transformative education.

METHOD

Research Design

This study employed a qualitative descriptive research design to provide a comprehensive and naturalistic description of how the deep learning system was implemented in an elementary school setting. The qualitative descriptive approach allows researchers to portray educational phenomena in detail, organizing data into meaningful categories without manipulating the observed situation. This design aligns with the framework proposed by (Colorafi & Evans, 2016), which emphasizes the importance of capturing participants' experiences and contextual information to understand the phenomenon holistically. Such an approach was considered suitable for this study because it enabled the researchers to closely investigate the practices of deep learning as they naturally occurred in the classroom at the selected school.

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Participants

The research took place at SD Negeri 46 Pagaralam, an elementary school located in Pagaralam City, South Sumatra Province. The participants in this study consisted of teachers and students directly involved in the deep learning activities at the school. Teachers were selected because they played a central role in implementing the learning model, including the principal (Mrs. R) and two Grade 5 teachers (Mrs. K and Mrs. L), along with one additional participant referenced during the interview sessions. Students who participated in lessons were also included to provide insight into how deep learning was experienced in practice. Participant selection used purposive sampling to ensure that only individuals with firsthand experience relevant to the research focus were involved. Participation was entirely voluntary, and informed consent was obtained from teachers and from parents or guardians of student participants. Ethical approval and permission were issued by the school administration, ensuring that the research met ethical standards of confidentiality, transparency, and respect for all participants involved.

Instruments

Three primary instruments were used to collect the data: interviews, observations, and documentation. Semi-structured interviews were conducted to explore the perspectives, experiences, and understanding of teachers and students regarding the implementation of deep learning. The interview questions were developed by the researchers and covered key aspects such as teachers' instructional strategies, students' engagement, the role of reflection, and the use of media and technology in learning. The interviews with the principal and teachers provided in-depth descriptions of how deep learning principles were applied in the school context. Classroom observations were conducted to capture authentic interactions and learning processes, focusing on instructional practices, student participation, classroom atmosphere, and the integration of technological tools such as virtual reality, augmented reality, digital videos, and game-based learning. These observations offered real-time evidence to complement the interviews. Documentation, including lesson plans, learning materials, and student reflection journals, was collected to enrich and validate the data, providing concrete records of instructional planning and learning activities.

Procedure

The research procedure began with the preparation stage, during which the researchers identified the research site, obtained permission and ethical approval, and prepared the instruments needed for data collection. The data collection phase included interviews with teachers and students, classroom observations during active learning sessions, and the gathering of relevant documents. To ensure the accuracy and credibility of the findings, the researchers triangulated the data by comparing information from different sources. Member checking was also conducted by sharing key interpretations with teacher participants to confirm whether the findings accurately represented their experiences and perspectives. This systematic procedure ensured that the data collected were reliable, valid, and aligned with the objectives of the study.

Data Analysis

Data analysis followed the qualitative analytical stages described by Ranney et al. (2015). consisting of data reduction, data display, and conclusion drawing. In the reduction stage, all interview transcripts, observation notes, and documents were examined to identify and code relevant information based on the research focus. The coded data were then organized into themes, which allowed the researchers to see recurring patterns and relationships. These themes were subsequently presented in descriptive narrative form to facilitate interpretation. The final stage involved drawing conclusions by synthesizing the thematic findings and verifying them through repeated cross-checking with the raw data. This iterative process ensured that the conclusions were firmly grounded in the evidence collected and accurately reflected the implementation of the deep learning system at the research site.

RESULT AND DISCUSSION

Transformative education can be realized through a deep learning system in primary schools by taking into account the emotional and cognitive development characteristics of primary school children. This way, the desired transformative education will not only touch on the academic realm of children but will also have a positive impact on character building, critical thinking skills, self-awareness, and human values within students. (Li, Tang, Chandler, & Nanni, 2025). Based on the results of research that has been conducted, transformative education using a deep learning system can be realized through meaningful learning, reflection and self-awareness, inquiry-based learning, the use of technology in learning, and the creation of a democratic and emotionally positive classroom environment.

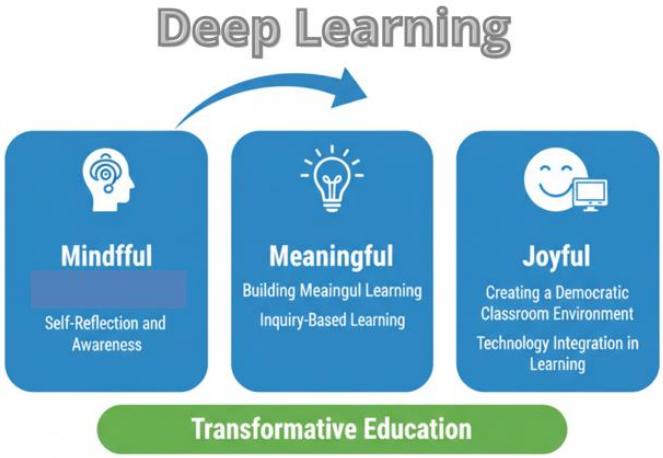

Figure 1. Research Results

The results of an interview with Mrs. R explained that students should not only be taught theory but should also be taught using contextual learning so that the material being studied can be understood comprehensively by the students. Based on the results of an interview with K, meaningful learning can be practiced by involving students in the learning process, commonly known as Student-centered learning. In addition, based on the results of an interview with L, meaningful learning focuses on understanding rather than memorization, so that learning in the classroom must be oriented towards understanding and not memorization.

According to Mrs. K, self-awareness in deep learning means that students do not learn because they are forced or promised certain rewards. Instead, they must learn based on a deep sense of self-awareness that is embedded in their souls, driven by the realization that the knowledge they acquire will be useful in the future, not just for the sake of grades or recognition. R also explains that reflection in learning is an important part of efforts to realize transformative education. Reflection and self-awareness are carried out by L by directing students to create weekly reflection journals, where students are asked to write about the material studied that week, what material was most difficult to understand, and so on.

Mrs. K explained that inquiry-based learning encourages students to take an active role in the learning process so that they can solve problems that arise. Mrs. L also explained that inquiry-based learning is closely related to deep learning. One example of inquiry-based learning used by Mrs. L is explaining the relationship between population growth and deforestation. Students then identify

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problems related to this issue and find their own solutions to these problems.

According to Mrs. L, deep learning is not rigid, let alone stressful or frightening for students. Based on the results of interviews conducted by K, the integration of technology in deep learning can be done by using digital learning media such as VR, AR, learning videos, game-based learning, and materials packaged in PowerPoint.

According to Mrs. K, a democratic environment can motivate students and make them feel valued and comfortable in learning, thus making learning meaningful and enjoyable. This is in line with Mrs. R's opinion, who explains that a concrete example of this is deep learning that is oriented towards understanding rather than memorization so that students will learn according to their interests and desires rather than because of coercion from teachers. According to Mrs. L, creating a democratic classroom environment can be achieved by frequently opening up space for open discussion.

Deep learning-based learning in primary schools has great potential to shape a transformative educational process. However, according to Mrs. K, a number of obstacles have been encountered in the field, such as teachers' limited understanding of the concept of deep learning pedagogy, a lack of relevant training, and the unpreparedness of digital infrastructure as the main support for the implementation of this method in primary schools. In addition, the implementation of deep learning requires a shift from conventional teaching patterns to collaborative, reflective, and project-based learning. Many teachers still face difficulties in designing a curriculum that encourages students to explore ideas in depth due to time constraints and administrative burdens.

Building meaningful learning

Meaningful learning, commonly referred to as meaningful learning, is an important part of deep learning. Meaningful learning can be defined as learning that is contextual to the lives of learners so that the meaning implied in learning is not only understood theoretically by learners but can also be well understood and implemented in everyday life (Sausan et al., 2025).

Involving students in the learning process can make it easier for them to understand how the material they are learning relates to real life (Wang, Liu, & Tu, 2025). Based on the results of research, engaging learning is learning that is not only carried out through memorization but also by instilling understanding in students regarding the material being taught. This is supported by the opinion of QI and Kawan Kawan, who explain that rote learning tends to limit children's thinking to what they have memorized, without using their reasoning and thinking to learn (Qi et al., 2023). This is because learning that relies on memorization is easily forgotten by students, whereas learning that focuses on understanding will be remembered for a long time, or what is commonly known as long-term memory. Meaningful learning carried out by L is implemented using various models and methods, ranging from role-playing to question-and-answer sessions and discussions. Two-way learning between teachers and students can make learning more meaningful and enjoyable. L emphasizes that one of the efforts towards transformative education is to use deep learning as a learning approach.

Reflection and self-awareness

Reflection and self-awareness are two distinct yet interrelated concepts. The deep learning system strongly emphasizes self-awareness among learners (Salem, Hashimi, & El-Ashry, 2025). If self-awareness has been well established, then the process of self-reflection will also run smoothly. This was expressed by R, who explained that reflection in learning is an important part of efforts to realize transformative education, because reflection can enable students to understand material that is related to their own learning experiences, so that students can use critical reasoning in summarizing the material studied.

According to L, reflection and self-awareness can be practiced in the learning process through learning that is not only oriented towards results/values but also oriented towards the process of learners participating in classroom learning. This is reinforced by Mrs. R's opinion, which explains that deep learning is not just about teaching material and then giving students worksheets to measure

their knowledge, but more than that, the learning that is carried out must motivate students to learn not for grades, but for knowledge that will be useful in the future. In addition, the daily journal method used by L can help students understand their weaknesses and strengths in learning, as well as take responsibility for their learning.

Inquiry learning strategy

Inquiry-based learning is very useful in honing students' critical thinking, collaboration, and problem-solving skills. This was conveyed by Mrs. K, who explained that inquiry-based learning encourages students to take an active role in the learning process in order to solve problems that arise, so that students act as subjects and teachers only act as facilitators. This will make learning more meaningful for students so that the knowledge gained through inquiry-based learning can be used in everyday life. This was reinforced by Mrs. L's opinion, who explained that inquiry-based learning is closely related to deep learning, as it can provide conscious and meaningful learning. Students will realize the importance of this learning in solving problems in their lives, and they will interpret this learning as an effort to find solutions to existing problems (Arifin, Sukarmin, Saputro, & Kamari, 2025). One example of inquiry-based learning conducted by Ms. L was explaining the relationship between population growth and deforestation. The pupils then identified problems related to this issue and sought solutions to these problems themselves. This type of learning not only helps pupils understand the material being taught but also trains them to think critically and logically.

Using technology in learning

One important aspect that must be implemented in the application of deep learning is joyful learning. According to Ms. L, deep learning is not rigid, let alone stressful or frightening for students. Deep learning should be enjoyable and exciting so that students will be more comfortable in the learning process, and it is hoped that this will create a democratic and positive classroom atmosphere.

Based on the results of interviews conducted by K, the integration of technology in deep learning can be done by using digital learning media such as VR, AR, learning videos, game-based learning, and materials packaged in PowerPoint. This can be useful for making the learning process more varied and less monotonous so that learning can be made enjoyable (Joyful Learning). (Consoli, Désiron, & Cattaneo, 2023). This is reinforced by observations showing that classes are active and exciting when teachers deliver material using AR and evaluate learning using Quizizz, with students showing great enthusiasm for learning that integrates technology into the learning process.

Creating a democratic and emotionally positive classroom environment

Deep learning emphasizes giving students space to actively participate in the learning process. According to Mrs. K, a democratic environment can motivate students and make them feel valued and comfortable in their learning, thereby making learning meaningful and enjoyable. This is in line with Mrs. R's opinion, who explains that a concrete example of this is that deep learning is oriented towards understanding rather than memorization so that students will learn according to their interests and desires rather than because of coercion from the teacher. This is beneficial as an effort to strengthen students' positive emotions so that students can feel safe when learning in class.

According to Mrs. L, creating a democratic classroom environment can be achieved by frequently opening up space for open discussion. Teachers, as facilitators, should give students the freedom to express their opinions and respect their diversity, thereby creating a positive and open classroom atmosphere. In addition, according to Mrs. L, occasionally involving students in decision-making will guide teachers in providing learning that is in line with the students' wishes (Alonso-Tapia & Ruiz-Díaz, 2025).

Challenges and obstacles in implementing deep learning

This study reveals that the use of deep learning at the primary school level plays an important role in creating transformative education. However, the implementation of this method faces various

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obstacles, such as limited teacher knowledge of deep learning pedagogy, a lack of appropriate training, and the unpreparedness of digital facilities as a key support, thus requiring appropriate handling.

In-depth discussion shows that implementation barriers stem not only from technology but also from changes in mindset within the education sector. Deep learning requires a shift from traditional learning systems to more reflective, collaborative, and project-oriented approaches, while teachers often find it difficult to develop curricula that emphasize in-depth exploration of ideas due to time constraints and heavy administrative workloads. In addition, a school culture that still emphasizes exam results also hinders the emergence of learning transformation. Support from education regulations, improvement of teacher skills, and provision of adequate facilities are essential for the optimal adoption of deep learning methods in primary schools.

Solutions to these obstacles can be implemented through strategies to strengthen teacher capacity, improve infrastructure and curriculum, and foster collaboration among all parties in the education sector. Professional development for teachers through applied training programs and intensive discussions needs to be encouraged, along with efforts to comprehensively introduce the deep learning paradigm to students and parents. Furthermore, technological facilities and learning resources must be gradually improved so that deep learning can be implemented effectively and continuously evaluated.

In addition, the development of a more responsive, flexible curriculum that meets the needs of students, as well as government policy support, will form the basis for sustainable educational innovation (Vuuren, Muller, & Strydom, 2023). Synergy between all stakeholders in education and continuing training is key to overcoming challenges so that the implementation of deep learning can drive real educational transformation in primary schools.

CONCLUSION

Deep learning in primary schools can drive educational transformation if it is implemented through meaningful learning approaches, inquiry-based learning, the use of technology, and the development of a democratic and emotionally positive classroom environment. Schools are encouraged to design teacher training programs that are relevant to deep learning pedagogy, including the integration of inquiry-based methods and the use of technology based on contextual needs. Teachers can also apply self-reflection, group discussions, and the use of digital platforms such as VR, AR, or educational games to make learning more suited to the characteristics of students. In addition, schools are advised to provide adequate internet facilities and other supporting facilities to create an inclusive and democratic learning environment. The scope of this study is limited to one region and a specific type of primary school, so the findings cannot be generalized to all schools with diverse infrastructure or resource characteristics. This study also focuses more on the implementation process, while the long-term impact on student academic achievement has not been the main focus. For future development, it is recommended that subsequent research explore the effectiveness of deep learning models in different subjects and broader levels, utilizing quantitative and longitudinal approaches in assessing students' cognitive, affective, and character development, as well as conducting comparative studies between regions with different levels of technological readiness to support more adaptive education policies.

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