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The Implementation of Deep Learning to Improve the Effectiveness and Quality of IPAS Learning in Elementary School

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Abstrak

Peningkatan kualitas pembelajaran Ilmu Pengetahuan Alam dan Sosial (IPAS) di tingkat sekolah dasar menjadi fokus utama dalam menghadapi tantangan era digital. Penelitian ini bertujuan untuk mengeksplorasi implementasi pendekatan deep learning dalam pembelajaran IPAS kelas 3 di SD X, Kota Probolinggo. Pendekatan ini mengintegrasikan tiga aspek utama pembelajaran, yaitu *meaningful learning*, *mindful learning*, dan *joyful learning*, untuk menciptakan lingkungan belajar yang lebih bermakna, reflektif, dan menyenangkan bagi siswa. Penelitian ini menggunakan metode kualitatif dengan desain studi kasus. Data dikumpulkan melalui observasi partisipatif, wawancara mendalam, dan studi dokumentasi. Hasil penelitian menunjukkan bahwa penerapan pendekatan deep learning secara efektif meningkatkan pemahaman siswa terhadap konsep ekosistem melalui pembelajaran berbasis proyek, jurnal refleksi, serta integrasi elemen budaya lokal. Strategi pembelajaran kontekstual terbukti membantu siswa mengaitkan materi pembelajaran dengan pengalaman nyata, meningkatkan keterampilan berpikir kritis, serta memperkuat kemampuan sosial siswa. Kesimpulannya, pendekatan *deep learning* efektif dalam meningkatkan keterlibatan siswa dan kualitas pembelajaran IPAS di sekolah dasar, terutama pada konteks sekolah semi-urban yang memiliki keterbatasan infrastruktur digital.

Kata Kunci: *Deep Learning*; Sekolah Dasar; Pembelajaran IPAS

Abstract

Improving the quality of natural and social sciences (IPAS) learning at the primary school level is the main focus in facing the challenges of the digital era. This study explores implementing a deep learning approach in learning IPAS grade 3 at X Elementary School, Probolinggo. This approach integrates three main aspects of learning, namely meaningful learning, mindful learning, and joyful learning, to create a more meaningful, reflective, and fun learning environment for students. This research uses qualitative methods with a case study design. Data were collected through participatory observation, in-depth interviews, and documentation studies. The study results show that applying the deep learning approach effectively improves students' understanding of ecosystem concepts through project-based learning, reflection journals, and integration of local cultural elements. Contextual learning strategy is proven to help students link learning materials with real experiences, improve critical thinking skills, and strengthen students' social abilities. In conclusion, the deep learning approach effectively enhances student engagement and the quality of IPAS learning in elementary schools, especially in semi-urban schools with limited digital infrastructure.

Keywords: Deep Learning; Elementary School; IPAS Learning

INTRODUCTION

The continuous advancement of technology and science in recent years has brought about significant changes in various fields, including education. Digital innovations not only affect learning methods but also change the way students interact with knowledge. This development requires the education system to adapt to a more flexible and dynamic approach to prepare learners for the challenges of globalization. Digitalization of education is no longer an option; instead, it is necessary to create a more interactive and practical learning environment to meet the demands of the times. In line with Sari (2024) opinion, using digital technology has become an essential element in learning innovation to improve the effectiveness of classroom activities. Integrating digital technology into learning can increase student engagement, facilitate collaborative learning, and support more personalized and adaptive learning.

In addition, according to Masinambow (2025), digital innovation in school management can improve the efficiency of administration, teaching-learning processes, and Communication. Using information technology, schools can better manage administration, teaching-learning processes, and Communication. However, implementing digitalization in education also faces challenges, such as gaps in access to technology and the need for teacher training. Therefore, effective strategies are needed to overcome these obstacles so that digital innovations can be applied optimally and evenly, improving the quality of education at various levels.

Fundamental educational system changes demand a paradigm shift from conventional learning models towards more adaptive and innovative approaches. Traditional models that centre on the teacher as the only source of knowledge are shifting towards more collaborative learning, where students are actively involved in exploration and problem-solving. According to Aziz & Zakir (2022), technology has become a tool that enables the

personalization of learning so that each learner can develop their potential according to their learning style and needs. Thus, the education system can respond more to social dynamics and accelerate industrial development.

In the ever-evolving digital era, learning must be designed to be more relevant, contextual, and meaningful to learners. According to Mustika (2024), meaningful learning focuses on theoretically understanding concepts and emphasizes the connection between subject matter and students' experiences. By presenting learning in a real-world context, students can more easily understand and apply the concepts they learn so that the learning process becomes more effective. The integration of technologies such as augmented reality (AR), virtual reality (VR), and artificial intelligence (AI) is also increasingly important in building 21st-century competencies. These technologies allow students to explore abstract concepts more visually and interactively, encourage more independent learning, and open access to various global learning resources. Thus, technology is a tool and a pedagogical strategy that can enhance the critical, analytical, and creative thinking skills needed in the future.

In addition to cognitive aspects, meaningful learning also helps build students' social and emotional skills. Experiential and collaborative approaches allow them to collaborate on accomplishing tasks that are relevant to real life. Students understand academic material through project activities, discussions, and simulations and hone their Communication skills, teamwork, and empathy for others. In addition, interaction with the global community through digital platforms broadens students' horizons about various cultural perspectives. Therefore, educators must continue innovating learning methods that connect theory with practice and optimally utilizing technology to create a more effective and enjoyable learning experience.

Deep learning-based learning provides opportunities for students to build broader connections between theory and practice and

apply the concepts they have learned in various situations. In line with Diputera et al (2024) opinion, this approach involves memorising facts and learning to connect ideas, develop logical arguments, and critically evaluate various perspectives. Therefore, applying deep learning in education is an effective strategy for building 21st-century skills, which demand flexibility of thinking and high adaptability amid ongoing changes.

Integrating technology in basic education has become a significant focus on improving the quality of learning. Technological advances, especially in artificial intelligence (AI), have opened up great educational opportunities to provide more interactive and adaptive learning methods. One of the prominent innovations in this regard is the implementation of interactive learning based on deep learning. In line with Asep (2024) opinion, the deep learning approach has four main principles: deep understanding, concept integration, active and problem-based learning, and reflection and self-awareness. These principles emphasize that deep learning can help students develop critical and analytical thinking skills. Thus, deep learning has the potential to create a more effective learning environment where students not only passively receive information but are also actively involved in the learning process.

According to Diputra (2024), the application of deep learning dramatically impacts the quality of education, such as improving the quality of learning by encouraging students to understand and connect concepts, not just memorize. In addition, this approach also contributes to the development of higher-order thinking skills, such as critical thinking, reflection, and problem-solving. In addition, deep learning can support students' emotional well-being by reducing stress through more meaningful, enjoyable learning and encouraging higher-quality social interactions. This approach invites students to explore concepts more comprehensively to connect new information with their prior knowledge. In addition, deep learning also encourages students to think more reflectively

and critically about the material they learn. Mindful learning, where students understand the purpose and benefits of each material, is essential in creating a more meaningful learning experience. This helps students understand the material better and increases their motivation to learn as they feel more involved and in control of the learning process.

However, although the deep learning approach has great potential to improve the quality of education, its implementation at the elementary school level still faces various challenges. One of the main obstacles is students' low conceptual understanding of IPAS materials, especially the topic of ecosystems. Learning that is still conventional, centered on lectures and memorization, is less able to encourage student involvement in exploring the relationship between living things and their environment in depth. In addition, limitations in the use of contextual learning media and interactive technology cause students to have difficulty understanding abstract concepts such as food chains, symbiosis, and ecosystem balance. In line with the opinion of Hafidzhoh et al (2023), thematic learning based on experience and the surrounding environment can increase student involvement and meaningful understanding of concepts. This is reinforced by the findings of Astutik (2021), which states that the use of an interactive learning approach based on the environment of ecosystem material can significantly improve students' concept understanding and curiosity. Therefore, learning innovations such as deep learning approaches that combine elements of meaningful, mindful, and joyful learning are needed to improve the effectiveness of IPAS learning in grade 3 elementary schools.

Previous research shows that despite the challenges in implementing deep learning in primary schools, some schools have successfully implemented this approach with positive results. Among them is X Elementary School Probolinggo in Probolinggo City, which implemented deep learning to improve the quality of IPAS learning, especially on ecosystem

materials. Research conducted at this school shows that the application of deep learning allows students to more easily understand the concept of flat buildings by connecting learning materials with authentic experiences in the surrounding environment. In addition, the use of technology-based learning media that is simple and easily accessible has also proven effective in increasing student engagement. This is in accordance with the findings of Syah et al (2025), who stated that the use of technology in learning can improve the interaction between students and learning materials and facilitate more enjoyable and meaningful learning.

Based on this literature review, it can be concluded that although the implementation of deep learning in primary schools faces various challenges, especially related to limited infrastructure and access to technology, this approach has great potential to improve the quality of education. Therefore, this study aims to explore more deeply the implementation of deep learning in IPAS learning at X Elementary School Probolinggo, with a focus on ecosystems. This research is expected to contribute to developing learning approaches that are more effective and relevant to the educational context in semi-urban areas, as well as provide new insights into how deep learning can be adapted to IPAS learning in elementary schools.

The main objective of this research is to analyze the effectiveness of deep learning implementation in improving the understanding of the concept of flat shapes in grade 3 students at X Elementary School Probolinggo. Through this research, it is expected to find solutions that can overcome the obstacles faced by schools in implementing deep learning, as well as provide recommendations for the development of technology-based learning that is more adaptive and effective. This research is also expected to contribute to curriculum development that is more responsive to technological developments and the needs of 21st-century education. Thus, this research has a high relevance in improving the quality of IPAS learning at the primary school level. It can be a reference for other schools that

want to implement deep learning in their learning process.

METHODS

This research uses a qualitative approach with a case study design to explore the implementation of deep learning at X Elementary School Probolinggo, Probolinggo City. Case studies were chosen because they are suitable for examining the questions of "how" and "why" a phenomenon occurs in a real-life context, where researchers have limitations in controlling research variables. The selection of the research location was purposive, considering the position of X Elementary School Probolinggo as an elementary school in a semi-urban environment that is a pioneer in implementing deep learning. According to Creswell & Creswell (2020), selecting cases that have unique characteristics can provide deeper insights into an educational phenomenon.

The research subjects included principals, teachers, and students who were selected using a purposive sampling technique based on their roles in the learning process. The data collection technique used methodological triangulation, consisting of three main methods. First, direct observation of lessons that implement deep learning, using an observation guide developed based on indicators from the Ministry of Education. Second, semi-structured interviews with key informants to gain a comprehensive perspective on implementing deep learning. Third, the documentation study includes analyzing learning tools, students' work, and school policies related to the implementation of deep learning. This study aims to corroborate the findings obtained through observations and interviews (Bowen, 2022).

The data obtained were analyzed using the interactive model of Miles et al (2014), which consists of three main stages. First, data reduction was carried out by filtering and categorizing relevant data. Second, data was presented in a format that allowed further analysis and conclusion-making. Third, findings were verified by comparing the study results

with other supporting evidence to ensure the accuracy of the conclusions. Data validity was maintained by applying four trustworthiness criteria according to Guba & Lincoln (1981). Data credibility was obtained through triangulation of methods and sources and member-checking techniques. Transferability was maintained by providing rich contextual descriptions to apply the findings in similar situations. Systematic audits and discussions with experts in deep learning and basic education strengthened dependability and confirmability.

This research was conducted in three main stages. The preparation stage included developing the research design and instruments. The implementation stage involved collecting data in the field through observation, interviews, and documentation. The analysis phase involved interpreting the data and compiling a comprehensive research report. Ethical aspects were a significant concern in this study, following guidelines from Bryman (2021). All participants provided written informed consent, with special consideration for students requiring parental or guardian permission. Data confidentiality was strictly maintained, and findings were confirmed with participants to ensure accuracy of interpretation. The approach used in this study allowed for an in-depth exploration of the implementation of deep learning in primary school. In line with Denzin & Lincoln (2009) views, a qualitative approach helps to understand the experiences and meanings constructed by participants in the process of transforming learning at the primary level.

RESULTS AND DISCUSSION

Implementing the deep learning approach at X Elementary School Probolinggo creates a more meaningful, reflective, and joyful learning ecosystem for students. The three main aspects of meaningful learning, mindful learning, and joyful learning are harmoniously integrated, resulting in significant changes in educational practices at the school. This transformation focuses on academic achievement and prioritizes students' active engagement in understanding,

analyzing, and connecting learning to their daily lives. With a more student-centered approach, the learning environment becomes more dynamic, where students do not simply receive information but also play an active role in building their understanding through exploration, discussion, and actual field experiences.

In the aspect of meaningful learning, teachers at X Elementary School Probolinggo have implemented various strategies to ensure that learning is relevant to students' everyday lives. One of the approaches used is linking curriculum content with social, cultural, and environmental contexts, enabling students to understand the direct benefits of the knowledge they acquire. For example, in IPAS learning on ecosystem topics in grade 3, students are introduced to concepts such as food chains, biotic and abiotic components, and ecosystem balance through classroom discussions and real-world observations. Students are encouraged to explore their schoolyard or nearby environments to identify living and non-living components, observe interactions among organisms, and reflect on how changes in the climate affect ecosystems. This approach resonates with Mariani et al (2024), who emphasize integrating deep learning and meaningful pedagogy in providing context-based, problem-solving experiences across disciplines—including language and science. Such pedagogy enhances student agency and fosters deeper cognitive engagement. This experiential approach helps students realize that ecosystems are not just abstract ideas in textbooks but living systems they are a part of and responsible for.

In addition, implementing mindful learning at X Elementary School Probolinggo focuses on increasing students' awareness of their thinking and learning processes. Teachers use metacognitive strategies, such as reflection journals, focus group discussions, and feedback sessions, to help students understand how they learn and identify difficulties encountered. In this way, students absorb information and can reflect on their understanding, find more effective

learning strategies, and increase their independence in learning. This approach aligns with 21st-century learning, emphasizing the importance of critical thinking and problem-solving in facing the challenges of an ever-evolving world.

In addition, joyful learning is a key element that makes learning more interesting and fun for students. Teachers integrate various creative and interactive activities in learning, such as traditional games, local cultural arts, and hands-on activities that actively involve students. With the element of local culture in learning, students feel more connected to the material taught and have a sense of pride in their cultural identity and heritage. According to (Kusumaningrum et al (2024), joyful and literacy-rich learning environments-particularly when combined with quality children's books-boost students' interest in reading and improve their social-emotional development. This approach makes students more enthusiastic about learning and creates an inclusive school environment that supports their social-emotional development. Overall, the implementation of deep learning at X Elementary School Probolinggo proves that with the right strategies, learning can be more meaningful, reflective, and fun for students while improving the overall quality of education.

The meaningful learning approach at X Elementary School Probolinggo aligns with the concept proposed by Hafidzhoh et al (2023), emphasizing the importance of linking new knowledge with students' life experiences and contexts. Teachers creatively develop various learning strategies that allow students to connect the subject matter with their surroundings directly. For example, in IPAS learning on ecosystems, students explore their environment to observe interactions between living things, such as plants, insects, and animals, and how they depend on non-living elements like water, sunlight, and soil. They may investigate simple food chains in the school garden or document how pollution affects nearby plants. This real-world connection helps students grasp ecosystem concepts more deeply and makes the

learning process more engaging and meaningful. Furthermore, this approach encourages students to think critically about environmental issues and to develop solutions based on their observations and understanding.

Implementing meaningful learning in this school also involves using experiential projects that allow students to learn actively through exploration and interaction with the surrounding environment. For example, in science lessons, students can conduct simple experiments using materials easily found at home or school. This approach helps students understand concepts more deeply and fosters a sense of ownership of their own learning. Teachers also use discussion and reflection approaches to help students connect their learning experiences to real situations they face. Thus, learning becomes more personalized and contextualized, allowing students to build stronger and longer-lasting understanding.

In addition, implementing mindful learning at X Elementary School Probolinggo focuses on increasing students' awareness of their thinking and learning processes. Teachers use metacognitive strategies, such as reflection journals, focus group discussions, and feedback sessions, to help students understand how they learn and identify difficulties encountered. This aligns with research by Saputro et al (2024), who found that mindfulness practices significantly contribute to students' creative reading comprehension abilities at the elementary level. Although the context of that study was literacy, the findings underscore the importance of mental presence and reflective awareness in learning, which is also highly relevant to IPAS learning-especially when students are engaged in observing and analyzing environmental phenomena such as ecosystem interactions. By cultivating mindfulness, students become more attentive during observation, more thoughtful in group discussions, and more capable of synthesizing their experiences into conceptual understanding.

The various learning innovations developed reflect the school's success in implementing

joyful learning. Teachers create a fun learning atmosphere by integrating traditional games, local cultural arts, and experiential activities that actively engage students. This approach makes learning more interesting and plays a role in preserving local culture. Not only that, according to Syah et al (2025) through the interactive features provided, students not only receive material passively but are also invited to actively participate in exploring concepts, solving problems, and reflecting on their understanding. This approach is designed to overcome conceptual difficulties that students often experience. One unique aspect of implementing joyful learning in this school is the integration of Probolinggo's distinctive cultural elements into learning. Traditional games and local arts are used as learning media, creating a learning experience that is both fun and culturally valuable. This strategy aligns with Darling-Hammond et al (2020) research that emphasizes presenting a joyful learning atmosphere without putting aside the subject matter's essence.

In the face of implementation challenges, schools are developing innovative adaptation strategies to ensure that limited digital infrastructure does not become a bottleneck in the learning process. One of the steps taken is to combine simple technology with experiential learning. For example, in IPAS learning, students can still access materials through printed teaching materials and group discussions before using digital media for further exploration. This approach balances hands-on experience in the field and using technology as a tool rather than the sole source of learning. Thus, the hybrid learning model implemented at X Elementary School Probolinggo ensures that all students get a meaningful learning experience, regardless of limited access to digital devices.

In addition to adaptive learning strategies, teacher professional development is a significant factor in successfully implementing deep learning in this school. Teachers receive ongoing training focusing on innovative learning methods and more effective classroom management strategies. One of the initiatives implemented is a mentoring

system, where senior teachers share their experiences and best practices with more junior teachers. The program accelerates teachers' adaptation to changes in learning methods and builds a culture of collaboration and reflection within the educator community. With mentoring, teachers feel more confident in implementing deep learning-based learning strategies and are able to adapt them to their students' needs and characteristics.

The positive impact of implementing the deep learning approach can be seen in improving students' critical thinking skills. In line with the opinion of Maharani et al (2019), implementing a systematically designed learning approach can improve students' critical and creative thinking skills. Analysis of students' work showed significant development in their ability to identify problems, evaluate information, and propose creative and innovative solutions. Students are no longer passive data recipients but can process, apply, and connect their knowledge to real situations. This shows that deep learning fosters an analytical and problem-solving mindset essential for students' academic development and daily life.

In addition to cognitive improvement, students' character and social skills also experienced significant development. In line with the "6Cs" concept proposed by Astuti (2024), students showed progress in collaboration, Communication, critical thinking, creativity, citizenship, and character. In project-based learning activities, they became more skillful in cooperating with group mates, sharing tasks fairly, and conveying their ideas clearly and effectively. Not only that, experiential learning also increases students' social awareness. They become more sensitive to the surrounding environment and can show empathy towards friends who have difficulties in learning. Thus, implementing deep learning at X Elementary School Probolinggo brings positive academic impacts and helps shape a generation of students with strong social competence and character.

The implementation model of deep learning in grade 3 IPAS learning at X Elementary School Probolinggo illustrates how an elementary school can successfully transform ecosystem-related learning into a meaningful experience, even in an environment with limited resources. This achievement demonstrates that educational innovation is possible when there is a strong commitment from all stakeholders and a well-planned adaptation strategy. The findings of this study provide valuable insights into how primary schools in Indonesia, particularly those in semi-urban areas, can integrate cognitive, social-emotional, and environmental awareness into the learning process. Such integration empowers schools to develop more holistic and meaningful learning models, enabling students not only to understand ecosystem concepts but also to care for and engage with their natural surroundings responsibly and reflectively.

CONCLUSIONS AND SUGGESTIONS

Research on the application of deep learning in IPAS learning in grade 3 on the topic of ecosystems at X Elementary School Probolinggo shows the school's success in implementing the three main aspects of learning: meaningful learning, mindful learning, and joyful learning. This transformation has brought significant changes in educational practices at the school, allowing students to engage more deeply with environmental concepts through exploration, reflection, and culturally relevant learning experiences.

The meaningful learning approach links learning with local problems and students' daily lives. One example is the flat measurement project, which consists of observing objects in the school environment. This activity allows students to understand theoretical concepts while applying them in real situations, individually and in group work.

Meanwhile, mindful learning is realized through structured metacognitive strategies, such as reflection journals and focus group discussions. Teachers adapt learning methods to

local socio-cultural conditions, ensuring the reflection process and language are relevant to students' daily experiences. In joyful learning, learning innovation is developed by integrating traditional games and cultural arts typical of Blora. This approach creates a fun learning atmosphere and enriches students' insights into local culture.

Faced with various implementation challenges, the school adopts a hybrid learning model that combines simple technology with hands-on learning experiences. In addition, a continuous professional development program is implemented to improve teachers' capacity for managing deep learning-based learning.

The results of this implementation show positive impacts, such as improved students' critical thinking skills, strengthened character and social skills by the "6C" concept, and increased learning motivation. This success proves that limited resources are not a barrier to implementing learning innovations as long as there is a strong commitment and the right adaptation strategy. The model implemented at X Elementary School Probolinggo clearly shows that schools in semi-urban areas can make meaningful educational transformations by integrating cognitive, social-emotional, and cultural aspects in learning.

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