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Improving Digital Literacy Skills With The Application Of Deep Learning Technology In Absorbing Information, Creating Information, And Evaluating And Creating Learning

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Abstract

Background. Digital literacy has become the primary foundation in facing the digital era. The ability to absorb, evaluate, create, and communicate digital information is an essential competency.
Aims. This research aims to describe how deep learning technology can enhance students' digital literacy skills, particularly in absorbing information, creating content, and evaluating and creating learning materials.
Methods. The method employed is a qualitative documentation study. Data were obtained from academic literature, education policies, and the latest research results related to deep learning and digital literacy.
Result. The results of the survey demonstrate that integrating deep learning technology in education can accelerate access to information, enhance critical thinking skills, and foster an adaptive, reflective, and data-driven learning system.
Conclusion. Deep learning technology has great potential in supporting digital literacy, a primary competency of the 21st century.
Implementation. The successful implementation of this technology requires systemic support to create transformative education and foster a generation of reflective, adaptive, and ethical learners.

Keywords: digital literacy, deep learning, educational technology, documentation studies, digital learning.

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INTRODUCTION

Digital literacy has become the primary foundation in facing the digital era. The ability to absorb, evaluate, create, and communicate digital information is an essential competency. (Firmansyah et al., 2024). However, based on data from Kominfo and Katadata (2023), the level of digital literacy among the Indonesian people remains in the medium category, particularly in terms of critical thinking and producing quality digital content. (Ramdani et al., 2020). *Deep learning*, as part of artificial intelligence, is a potential solution to support digital literacy by creating personalized, interactive, and data-driven learning experiences.

Digital literacy has become the primary foundation for navigating the digital era, characterized by the rapid flow of information, technological transformation, and disruption in nearly all aspects of life. (Firmansyah et al., 2024). In the context of education, digital literacy does not only mean the ability to use technological devices such as computers and the internet, but also includes complex competencies that involve skills to access, understand, analyze, evaluate, create, and communicate digital information effectively, critically, creatively, and ethically. (Delia Maharani & Latifah Meynawati, 2023).

The ability to absorb, evaluate, create, and communicate digital information is now a crucial prerequisite for students to thrive and develop in the digital age. Digital literacy is also a crucial skill in navigating the increasingly technology-based learning environment, including online learning, the use of Learning Management Systems (LMS), digital collaboration, and social interaction in cyberspace. Without adequate digital literacy, students are vulnerable to misleading information, disinformation, and misuse of personal data, and are marginalized from global self-development opportunities. (Brown et al., 2005).

However, actual conditions indicate that the level of digital literacy among the Indonesian people, including students, is still classified as "moderate". Based on a national survey conducted by the Ministry of Communication and Information Technology (Kominfo) in collaboration with the Katadata Insight Center in 2023, it was found that many students have difficulty sorting out valid information on the internet, and have not

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been able to produce informative, accurate, and ethical digital content optimally. Aspects of critical thinking, online collaboration, and moral awareness in the use of digital technology still require significant improvement. This phenomenon reveals a gap between technical capabilities and a profound understanding of the context of digital information received and disseminated. (Firmansyah et al., 2024).

On the other hand, the development of artificial intelligence (AI) technology has provided new hope in overcoming these challenges. One of the branches of AI that holds great potential in the world of education is deep learning. (Decheng Zhang & Jinxin Chen, 2024), which enables computers or digital systems to simulate the way the human brain operates in recognizing patterns, understanding context, and making informed decisions. Deep learning can process large amounts of data, build adaptive models, and provide a personalized and interactive learning experience according to the needs, characteristics, and preferences of each learner. (Chan, 2023).

In the context of education, the application of deep learning is not only limited to technical aspects such as voice or image recognition, but also begins to penetrate the development of adaptive learning systems, learning analytics, and automatic evaluation based on natural language processing. This technology can support learners in accessing material that suits their level of understanding, providing real-time feedback, and leading them to explore further information independently. (Grover & Sindhu, 2024)

Therefore, the integration of deep learning technology in the education system is seen as a strategic approach to strengthen digital literacy. This technology enables more meaningful and contextual learning, empowering students to become not only consumers of information but also creators and evaluators of digital information that is active, critical, and responsible. (Badrudin, 2019). Thus, digital literacy and deep learning technology form a mutually supportive relationship, becoming an essential foundation in the transformation of education towards a more inclusive, adaptive, and future-oriented digital era. (Hakim & Saryulis, 2023a).

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LITERATURE REVIEW

Digital Literacy

Digital literacy includes not only the use of digital devices but also the ethical and critical understanding, evaluation, and creation of digital information. (Asiyah, 2021). Digital literacy is essential for detecting disinformation, maintaining data privacy, and contributing to collaborative learning. Digital literacy is one of the essential skills for navigating the era of Industrial Revolution 4.0 and Society 5.0. This literacy includes not only technical skills in operating digital devices such as computers, tablets, and smartphones, but also critical thinking skills in filtering and evaluating information available online, as well as skills in creating digital content ethically, accurately, and responsibly (Ramdani et al., 2020). According to UNESCO (2021), digital literacy is part of 21st-century literacy that not only focuses on access to and use of technology, but also on cognitive, affective, and social aspects in the use of digital information (UNESCO, 2021).

In the context of education, digital literacy is the main foundation in the modern learning process. It is not enough for learners to have basic skills to use software or surf the internet, but they must also be able to understand information structures, distinguish between valid and invalid information, recognize bias or disinformation, and be able to synthesize information from various sources to build a deep and original understanding. (Hakim & Saryulis, 2023a).

Digital literacy also includes the ability to think critically about digital content. This means that learners must be able to assess the reliability of information sources, understand the communicative intent behind the content, and be aware of the influence of digital platform algorithms on the information they consume (Firmansyah et al., 2024). Without strong literacy, students are easily misled by hoaxes, digital radicalism, or information manipulation that is detrimental to themselves and their surrounding environment.

Furthermore, digital literacy encompasses the ability to create content. In this era, every individual has the potential to become an information producer, not just a consumer. Therefore, it is essential to teach learners how to create digital content—whether in the form of writing, videos, images, or multimedia presentations—that is both informative and

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engaging, and also adheres to digital ethical norms. It also includes awareness of copyright, personal data protection, and netiquette. (Chan, 2023).

Bawden (2021) states that digital literacy is the ability to understand and use information in various digital formats critically and creatively. This literacy requires an integration of technical skills, analytical skills, and sensitivity to the social impact of information disseminated in the digital space. Additionally, digital literacy is closely related to cybersecurity and privacy protection. Students must be trained to understand the risks associated with internet use, including identity theft, malware spread, and the exploitation of personal data by unscrupulous parties (Ramdani et al., 2020). Strong digital literacy will equip students with the ability to maintain the confidentiality of personal information, use secure passwords, and understand privacy settings across various digital platforms (Akhyar & Zalnur, 2024).

In digital-based collaborative learning, digital literacy also encourages the ability to communicate effectively and ethically. For example, the ability to participate in online discussions, respond politely to differing opinions, and collaborate on virtual projects is becoming an essential skill in an increasingly technology-reliant learning environment. (Firmansyah et al., 2024). Overall, digital literacy is a cross-disciplinary competency that every student must possess to participate actively and responsibly in the digital society. This literacy not only supports academic success but also fosters the development of character as an intelligent, critical, and ethical digital citizen. (Delia Maharani & Latifah Meynawati, 2023).

Deep Learning Technology in Education

Deep learning is a branch of machine learning that mimics the human brain's working process. Architectures such as CNNs and RNNs are particularly useful in processing visual and sequential data. In the world of education, deep learning is utilized for personalized learning, adaptive content development, and automated evaluation. Deep Learning technology is a branch of artificial intelligence (AI), more specifically machine learning, which focuses on the ability of computer systems to learn from data and make decisions automatically without explicit programming. (Warburton, 2003a). In contrast to traditional machine learning methods, deep learning mimics how the human brain works

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through artificial neural networks (*Artificial Neural Networks*), which have many layers, allowing the system to recognize complex patterns in the data.

One of the primary strengths of deep learning is its ability to handle large amounts of unstructured data, including images, videos, text, and sound. Popular architectures, such as Convolutional Neural Networks (CNNs), are widely used for image processing and visual pattern recognition. In contrast, Recurrent Neural Networks (RNNs) and their derivatives, including LSTM (Long Short-Term Memory), are highly effective in understanding sequential data, such as text or voice recordings. This ability is particularly relevant in the context of increasingly digitized education, where different types of data are used to design and evaluate the learning process. (Warburton, 2003a).

In education, deep learning technology has been applied in various ways, significantly transforming the learning paradigm. One of them is through personalized learning. By utilizing real-time student data analysis, deep learning systems can adjust the material, pace, and learning approach based on individual needs and abilities. This provides a more meaningful and inclusive learning experience, especially for students with diverse backgrounds and learning styles.

Additionally, deep learning promotes the development of adaptive and intelligent learning content. For example, the learning system can automatically recommend additional materials, practice questions, or learning videos that match the student's previous learning outcomes (Apriliani et al., 2024). These models not only rely on basic statistics but also analyze student interaction patterns in depth to respond to learning needs contextually.

This technology is also used in automated assessment. With *Natural Language Processing* algorithms, the system can assess essays, description answers, or online discussions by considering both semantic and contextual aspects, rather than just the number of words or keywords. This enables more objective, efficient, and sustainable assessments while reducing teachers' workload in evaluation activities.

Furthermore, deep learning is also applied in learning analytics. By collecting and analyzing student behavior data from digital learning platforms (such as LMS), the system can identify students who are at risk of learning difficulties early on, as well as provide predictive and preventive feedback. This helps educational institutions make informed

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decisions and improve the overall quality of learning. Other benefits include the development of educational chatbots, intelligent tutor systems, and virtual reality (VR) and augmented reality (AR)-based learning simulations, all supported by deep learning technology. All of this creates a learning ecosystem that is more interactive, reflective, and bridges the gap between theory and practice. (Grover & Sindhu, 2024). Thus, the integration of deep learning technology in education is not just a technological trend, but a strategic step in building a learning system that is responsive, efficient, and able to produce 21st-century learners who are independent, creative, and adaptive to change.

The Relationship between Digital Literacy and Deep Learning (Descriptive Narrative)

In today's fast-paced and technology-based digital era, digital literacy and deep learning are two essential elements in the world of education. The two have a close and complementary relationship, particularly in creating relevant, contextual, and future-oriented learning experiences. Digital literacy refers to a person's ability to use information and communication technology effectively, critically, and creatively. (Firmansyah et al., 2024). This literacy encompasses not only the ability to operate digital devices but also includes the skills to understand digital information, evaluate its credibility, and create valuable and responsible content. On the other hand, deep learning is a technological approach that allows computer systems to learn and make intelligent decisions through complex and layered data analysis, mimicking the way humans think. (Alpata & Zainuri, 2024).

The relationship between digital literacy and deep learning is evident in modern technology-based learning practices. To effectively utilize deep learning technology, students must first possess digital literacy skills (Putri et al., 2025). For example, when students use an AI-based learning platform or digital material recommendation system, they need to have the ability to navigate information, choose credible sources, and understand the available digital instruction. In other words, digital literacy is a crucial foundation for students to interact with deep learning-based systems to their fullest potential.

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On the other hand, the application of deep learning technology can also serve as a means to enhance students' digital literacy. When students engage in learning facilitated by intelligent technology, they indirectly learn how to filter information and think reflectively. (Auliya Nurul Faizah, 2024)Collaborate on digital platforms to solve complex problems with the help of technology. This process enriches their digital experience and fosters a deeper understanding of how technology supports the learning process. For example, in digital project-based learning, students are required to search for information on the internet, analyze data, create digital presentations, and publish them on specific platforms. These activities require high digital literacy skills and, at the same time, train individuals to understand and use technology responsibly. When deep learning systems participate in providing material recommendations or evaluating learning outcomes, students also learn to read feedback data and adjust their learning strategies. This is where it becomes clear that digital literacy and deep learning mutually support one another.

Furthermore, these interactions are not one-way, but rather like mutually reinforcing cycles. The better the digital literacy of students, the easier it will be for them to understand how deep learning technology works. Conversely, the more often they use deep learning-based systems in learning, the more their digital skills develop. (Assingkily & Mesiono, 2019). Therefore, the two cannot be separated in the context of 21st-century learning.

In the long term, the relationship between digital literacy and deep learning will shape students who are not only technologically savvy but also critical, reflective, and adaptive to change. They are not only users of technology, but also creators and evaluators of information that can have a positive impact on the surrounding environment. This is the ultimate goal of sustainable digital education: to create a generation of independent, intelligent, and responsible learners amidst the complexities of an all-digital age.

METHODS

This study employs a qualitative approach, utilizing a documentary study method. This approach was chosen to explore in depth the concepts, relationships, and implementation of *deep learning* technology in improving students' digital literacy. Data are collected through systematic document tracing from various sources, including

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scientific journals, reports from educational institutions, academic books, and relevant educational policies.

The document was analyzed using *content analysis techniques* by examining the content thematically to identify patterns, relationships between concepts, and important information related to digital literacy and *deep learning technology*. The researcher also considered the social and policy context behind the document, so that the results of the analysis provided a complete and contextual picture of the contribution of *deep learning* to the improvement of digital literacy in the digital learning era.

DISCUSSION

The Relationship between Digital Literacy and Deep Learning

There is a close two-way link between digital literacy and technology, *particularly in the context of deep learning in* modern education. Digital literacy is not only the initial foundation that allows students to access, understand, and use various forms of learning technology, but also an important prerequisite for them to utilize the system of *Deep Learning* optimally. (Putri et al., 2025). Students who possess good digital literacy skills will be better equipped to navigate various AI-based digital platforms, understand how learning algorithms work, and critically evaluate the information and recommendations provided by intelligent systems.

In other words, digital literacy equips individuals with the fundamental skills necessary to engage actively and productively with advanced learning technologies. For example, in an adaptive learning platform that utilizes deep learning algorithms to recommend material or questions based on students' abilities, learners must possess the ability to read data, understand learning visualizations, and interpret feedback provided by the system. (Firmansyah et al., 2024). Without digital literacy, students tend to be passive and merely undergo learning mechanically, without fully understanding the context and purpose of the process.

On the other hand, the application of Deep Learning technology also has a significant contribution in strengthening and improving students' digital literacy. Through experience using artificial intelligence-based learning systems, students will indirectly become familiar with complex digital environments, learn to recognize digital interaction

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patterns, understand the importance of data, and develop the ability to think reflexively and critically about the digital content they consume. Technology *Deep Learning.* It also encourages students to actively engage in the learning process, explore independent sources of information, and create more meaningful and contextual digital works. (Sari et al., 2024).

In practice, the relationship between digital literacy and deep learning is mutualistic and mutually reinforcing. The higher a person's level of digital literacy, the more effectively they can utilize deep learning technology in their learning. On the other hand, the more often students interact with deep learning-based learning systems, the more their digital literacy skills will be honed. This relationship creates a productive cycle in technology-based learning, where learners not only become users of technology but also become adaptive and critical independent learners during an ever-evolving digital environment. (UNESCO, 2021).

This relationship demonstrates that in building sustainable technology-based education, strengthening digital literacy and utilizing deep learning technology must go hand in hand. Teachers and educational institutions need to design learning strategies that not only utilize technology technically but also foster digital awareness, ethics, and students' critical thinking skills in using technology. Thus, education in the digital era can be a means of transformation that not only educates but also shapes students' character as intelligent, wise, and responsible digital citizens.

Application of Deep Learning in Education

The application of deep learning technology in education has had a significant impact on the way students learn, the way educators teach, and the way educational institutions develop more adaptive and data-driven learning strategies. This technology allows the learning system to be more intelligent, dynamic, and responsive to the individual needs of students. (Ramdani et al., 2020). By harnessing the power of algorithms that can recognize patterns from large amounts of data, *Deep Learning* can create a more effective, personalized, and meaningful learning experience.

One of the main contributions of *Deep Learning* in the world of education is its ability to personalize the learning process. Through the use of student activity data, such

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as learning speed, the level of success in completing assignments, and interaction with learning content, the system, based on Deep Learning, can automatically adjust the materials and learning approaches that best suit the needs of each student. Learning becomes no longer uniform, but rather individually designed, providing each student with a more relevant and optimal learning experience. This is very helpful in improving students' motivation, engagement, and learning outcomes because they feel that the learning process is tailored to their abilities and learning styles. (Hakim & Saryulis, 2023).

In addition to personalization, *Deep Learning* also allows the development of adaptive learning content that can adapt to the student's learning development. Digital content, such as interactive videos, adaptive quizzes, and e-learning modules, is no longer presented in a static form, but can adjust the level of difficulty, presentation style, and speed based on user interaction. For example, if a student has difficulty understanding a topic, the system can provide additional explanations, interactive visualizations, or simulations to reinforce their understanding. (Gusti & Karnati, 2021). Conversely, if students show good progress, the system can accelerate the material or provide more advanced challenges. This adaptive ability makes learning more dynamic and tailored to the individual development of each student.

In addition to supporting the learning process, Deep Learning technology also brings progress in terms of evaluation. System-based *Deep Learning* can be used for automatic assessments, either in the form of multiple-choice or explanation answers. With the support of natural language processing technology, or *Natural Language Processing (NLP)*, the system can analyze students' answers based on the meaning, structure, and coherence of their arguments, rather than just keywords. This allows for more objective and in-depth assessments, which can be completed in a significantly shorter timeframe than manual assessments (Hakim & Saryulis, 2023). In addition, the adaptive evaluation model enables the system to ask questions whose level of difficulty adjusts to the student's ability, resulting in more accurate evaluation results that reflect the students' actual abilities.

Furthermore, *deep learning* encourages increased student participation and creativity in the learning process, especially in the context of project-based digital learning. Students no longer consume information; they are also actively creating content, composing presentations, making educational videos, or developing digital solutions to

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real-world problems. In this process, *deep learning* systems can provide automatic feedback, help students evaluate the quality of their work, and recommend constructive improvements. This kind of learning environment shapes students who are not only technologically savvy but also think critically, creatively, and can collaborate in a digital context.

Challenges and Implications

Despite the technology *Deep Learning* offers various potentials and innovations in improving the quality of learning and digital literacy of students, its application in the context of education, especially in Indonesia, is inseparable from various significant challenges. These challenges encompass aspects of infrastructure, human resources, and the overall readiness of the education system. (Sari et al., 2024).

One of the main challenges is the gap in access to technology. Not all schools or students have adequate access to digital devices, stable internet networks, and artificial intelligence-based learning platforms. This creates a digital disparity between schools in urban and rural areas, as well as between public and private schools that have different resources. Without a supporting infrastructure, applying *Deep Learning* will be challenging to implement evenly, and can widen the gap in educational quality. (Assingkily & Mesiono, 2019).

Additionally, another significant challenge is teacher readiness. Many educators lack a sufficient understanding of deep learning technology, both in terms of its concepts, applications, and integration into the learning process. Some teachers still focus on conventional methods and feel less confident in adopting new technologies in their teaching. The lack of intensive and continuous training means that most teachers do not possess the digital competencies necessary to maximize the benefits of this technology. Therefore, increasing teacher capacity is the primary key to the success of *deep learning* integration in education.

Additionally, the curriculum, which is still limited and not adaptive to technological developments, is also an obstacle in itself. Many curricula are still content-oriented and memorized, while the implementation of *Deep Learning* demands a more flexible, exploratory, and problem-solving-based approach. Without curriculum support that is open

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to innovation, the application of advanced technology like this tends to be a temporary and unsustainable paste. (Warburton, 2003).

However, these challenges can be overcome through inclusive policies, structured teacher training, strengthening digital infrastructure, and progressive curriculum reforms. In that case, the integration of technology and *Deep Learning* in education will have extraordinary implications. One of them is the strengthening of 21st-century competencies known as the 4Cs: *Critical Thinking*, *Creativity*, *Communication, and Collaboration*. These four competencies are urgently needed in the increasingly complex and technology-based world of work and social life. (Habsy et al., 2024).

With the application of *deep learning*, students will be better equipped to think critically when filtering digital information, be creative in compiling learning content, communicate effectively through various digital platforms, and collaborate online to complete digital projects. They not only become users of technology, but also become reflective, adaptive, and able to make decisions independently based on accurate information analysis.

Therefore, although the integration of *deep learning* in education still faces various challenges, the implications are very strategic in shaping a generation of learners who not only master technology but also have strong character and deep thinking skills. The success of this transformation will depend heavily on the willingness and ability of all parties, from the government, educators, and the broader community, to build an education ecosystem that is ready to face the digital era in an empowered and sustainable manner.

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CONCLUSION

This research demonstrates that the integration of deep learning technology in education has significant potential to enhance students' digital literacy. Digital literacy encompasses not only technical skills but also the ability to think critically, evaluate, and creatively manage digital information. Deep *learning technology* accelerates an adaptive, personalized, and data-driven learning process, enriching the learning experience of students. The relationship between digital literacy and *deep learning* is two-way: digital literacy supports the optimal use of technology, while *deep learning* encourages the strengthening of students' digital competencies. Even so, its implementation still faces

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challenges, such as access gaps, teacher readiness, and a curriculum that is not yet adaptive. Therefore, the successful implementation of this technology requires systemic support to create transformative education and give rise to a generation of reflective, adaptive, and ethical learners.

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