

## The Implementation of Deep Learning for English Learning for College Students

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### ABSTRACT

This study aimed to determine (1) Implementation of deep learning in English language learning for students in higher education viewed from the integration of technological and pedagogical aspects, (2) Implementation of deep learning contributes to improving the quality of English language learning for students viewed from the cognitive and language skills aspects. This study used a descriptive qualitative approach with a library research method enriched with secondary empirical data from various research results, learning documents, and relevant scientific literature. Data analysis techniques were carried out through the stages of data reduction, classification, comparison, synthesis, and critical interpretation. The results show (1) The implementation of deep learning in English language learning for students in higher education has significant potential in improving the quality of learning if it is synergistically integrated between technological and pedagogical aspects. Deep learning technology is able to support more adaptive, personal, and data-based learning, especially in improving language skills such as writing, reading, and speaking (2) The implementation of deep learning contributes to improving the quality of students' English learning in terms of cognitive aspects and language skills. The literature shows that the implementation of deep learning in learning makes a significant contribution to improving the quality of students' English learning, especially in cognitive aspects and language skills. From a cognitive perspective, this technology encourages critical, analytical, reflective thinking skills, and problem solving through adaptive and interactive learning presentations.

**Keywords :** *Deep learning, English learning, Students*

### INTRODUCTION

The development of digital technology in the 21st century has brought significant changes to various aspects of human life, including education (Aladini et al., 2025; Feng & Pan, 2021). This transformation is marked by the presence of artificial intelligence-based technology that is able to change the learning paradigm from conventional to more adaptive, personalized, and data-driven (Avença et al., 2024; Guerrero et al., 2024; Ipanaqué-Zapata et al., 2023). In the context of English language learning, this technology opens up new opportunities to improve the quality of learning through a more interactive and responsive approach to student needs (Becker & Edalatshams, 2019). This is relevant because language learning requires not only mastery of structure but also dynamic communication skills. Therefore, technological innovation is an urgent need to answer the challenges of English language learning in the era of globalization (Afrianto et al., 2022).

One of the rapidly developing technological innovations is deep learning, a subset of artificial intelligence capable of processing large amounts of data through artificial neural networks (Liang et al., 2025). Deep learning has been widely used in

various fields, including natural language processing (NLP), which forms the basis for developing language learning applications. This technology enables systems to understand, analyze, and generate language in a more natural and contextual manner. Thus, deep learning has great potential to improve the effectiveness of English language learning at the tertiary level. This is in line with developments in educational technology that emphasize AI-based learning (Rahimi & Sevilla-pav, 2024).

In the context of English language education, the use of artificial intelligence, including deep learning, has demonstrated a positive impact on improving students' language skills. Various studies have shown that AI technology can significantly improve speaking, writing, reading, and listening skills. Furthermore, AI also contributes to increasing student motivation through a more personalized and flexible approach. This demonstrates that technology integration in English language learning is not merely complementary but has become a primary requirement for improving learning quality (Deore et al., 2025).

However, the implementation of deep learning in English language learning still faces various challenges. One of the main challenges is the readiness of the infrastructure and the digital

competence of lecturers in integrating this technology into learning. Furthermore, there is a gap between the rapid development of technology and the adaptability of educational institutions (Alqahtani & Alqahtani, 2023; Annamalai et al., 2023; Szymkowiak et al., 2021). This results in the utilization of deep learning in learning being suboptimal and still partial. In addition to technical factors, pedagogical aspects also pose challenges in the implementation of deep learning. Many studies show that AI technology is more effective when used as a complement, not a replacement, for traditional learning methods. This suggests that integrating deep learning into English language learning requires a holistic approach based on strong pedagogy. Without the right approach, the use of technology can actually reduce the quality of learning (Waluyo & Kusumastuti, 2024; Wilendra et al., 2024).

The use of deep learning in English language learning also raises concerns regarding students' dependence on technology. Several studies have shown that excessive use of AI can reduce students' critical thinking skills and creativity. Therefore, a balance is needed between technology use and the development of students' cognitive abilities (Belete & Alitasb, 2025). This is crucial to ensure that technology does not replace the learning process, but rather enhances it. In the context of higher education, students are required to have critical, creative, and independent thinking skills. Therefore, the implementation of deep learning in English language learning must be able to support the development of these skills. This technology is not only used to improve language skills but also to encourage students' reflective and analytical thinking. This is in line with research findings showing that AI can enhance students' self-reflection and creativity in language learning (Jiang, 2025).

However, research related to the implementation of deep learning in English language learning still has several limitations. Most studies still focus on the use of technology in general, without specifically examining the role of deep learning in the learning process. Furthermore, existing research tends to emphasize learning outcomes, without considering the learning process in depth. This indicates a research gap that requires further study. Most studies were conducted in developed countries with adequate technological support. This means that the results may not be relevant when applied to developing countries, such as Indonesia (Falikhah, 2017). Therefore,

research is needed that examines the implementation of deep learning in local contexts, taking into account existing social, cultural, and infrastructure conditions. This is crucial to ensure that the research results are highly relevant.

Another gap identified is the lack of research examining the integration of deep learning with specific pedagogical approaches in English language learning. Most studies only view technology as a tool, without integrating it with relevant learning theories (Vieira & Pedro, 2023). This results in suboptimal technology implementation and insignificant impacts. Therefore, research is needed that comprehensively examines the integration of technology and pedagogy. Existing research is also limited in examining the long-term impact of using deep learning in English language learning. Most studies were conducted over a short period of time, thus failing to depict the true impact. This is crucial to examine, given that language learning is a continuous and time-consuming process (Dini et al., 2020; Laily, 2015). Research on deep learning in English language learning is also limited in examining students' affective aspects, such as motivation, anxiety, and self-confidence. These aspects play a crucial role in successful language learning. Therefore, research is needed that comprehensively examines the cognitive and affective aspects of deep learning implementation.

This study aims to examine in-depth the implementation of deep learning in English language learning for university students. The main focus of this study is on how this technology can effectively improve students' language skills. Furthermore, this study will examine the factors influencing the successful implementation of this technology. Therefore, this study is expected to provide both theoretical and practical contributions to the development of technology-based English language learning. Theoretically, this research is expected to enrich the study of the integration of technology and pedagogy in language learning. Practically, this research is expected to provide recommendations for educational institutions in implementing deep learning technology.

## REVIEW OF RELATED LITERATURE

Deep learning is a branch of artificial intelligence that uses layered neural networks to process and analyze large amounts of data in a complex manner. In the context of English language learning, deep learning plays a role in the development of Natural Language Processing

(NLP)-based systems capable of understanding, generating, and evaluating language naturally. This technology enables the creation of adaptive learning systems, where materials, exercises, and feedback can be tailored to the needs and abilities of each student. Thus, deep learning functions not only as a tool but also as a facilitator, creating a more personalized and effective learning experience (Mohammad et al., 2026).

From a pedagogical perspective, the application of deep learning in English language learning can be linked to constructivism theory, which emphasizes the active role of students in constructing knowledge. Through deep learning-based technology, students can interact directly with learning systems that provide simulations, exercises, and real-time feedback. This encourages a deeper learning process (deep learning) rather than simply memorizing (surface learning). Furthermore, this technology integration also supports problem-based learning and adaptive learning approaches, enabling students to develop critical, analytical, and reflective thinking skills in understanding English.

Furthermore, the implementation of deep learning in English learning significantly contributes to the development of language skills, such as writing, reading, speaking, and listening. AI-based systems can provide automatic feedback on grammar, sentence structure, and pronunciation errors, helping students improve their accuracy and fluency. Furthermore, this technology also enables more flexible and independent learning, as students can access materials anytime and anywhere. Thus, deep learning is a crucial innovation in English learning in the digital era, capable of improving the overall quality of learning (Corral-Montoya et al., 2022).

## METHODOLOGY

This study employed a descriptive qualitative approach with a library research approach enriched with secondary empirical data analysis. This approach was chosen because the study focused on a conceptual assessment of the implementation of deep learning in university students' English language learning, without involving primary data collection through interviews or direct observation. The data used in this study were sourced from relevant scientific literature, such as reputable journal articles, academic books, proceedings, and previous research reports related to the application of deep

learning in education, particularly in English language learning in higher education.

## FINDINGS AND DISCUSSIONS

### How Deep Learning is Implemented in English Language Learning for College Students from the Integration of Technological and Pedagogical Aspects

The development of artificial intelligence technology has presented a new paradigm in English language learning in higher education (Stanley et al., 2001). The implementation of *deep learning* is no longer understood merely as a technical aid, but as a system capable of reconstructing the learning process as a whole (Deore et al., 2025; Jiang, 2025). In this context, the integration of technological and pedagogical aspects is the main key in determining the success of *deep learning-based learning*. The study findings indicate that the use of technology that is not balanced with an appropriate pedagogical approach tends to result in shallow learning. Therefore, an integrative approach is needed that can bridge the two systematically.

In line with this, literature analysis shows that the implementation of *deep learning* in English learning is often carried out through AI-based platforms such as adaptive learning systems and natural language processing applications. This technology allows students to receive real-time feedback on their language skills. Field evidence from various previous studies indicates that the use of these systems can increase student engagement in the learning process. However, its effectiveness is greatly influenced by the learning design used by lecturers (Liu, 2025).

The integration of technology and pedagogy is often partial. Many educational institutions adopt *deep learning technology* without adapting their learning strategies. This results in technology being used only as an aid, rather than as an integral part of the learning process. These findings indicate a gap between technological development and pedagogical readiness in higher education. Based on this, it is crucial to understand that *deep learning implementation* must be based on a clear pedagogical framework. Constructivism theory, for example, emphasizes the importance of active student involvement in constructing their own knowledge. In this context, *deep learning technology* can be used to provide an interactive and adaptive learning environment. Thus, learning focuses not only on knowledge transfer but also on

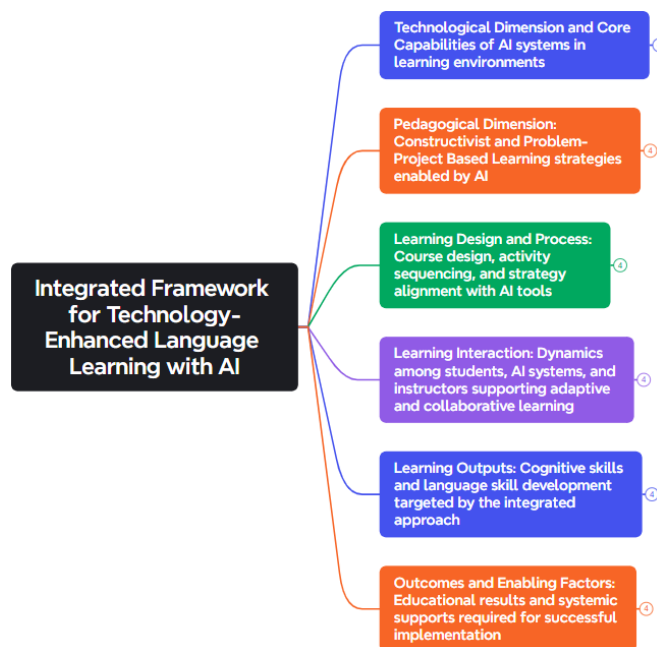
developing critical thinking skills (Deore et al., 2025).

Analysis of various studies shows that *deep learning* has significant potential to improve students' English skills, particularly in writing and speaking. This is due to the technology's ability to provide specific and personalized feedback. Secondary empirical data indicates that students who use AI-based systems tend to experience significant improvements in the quality of their writing. However, this improvement does not occur automatically, but rather depends on the intensity of use and the guidance of lecturers (Ingoley & Bakal, 2025). In the context of reading instruction, the implementation of *deep learning* has also shown positive results. AI-based systems can help students understand texts more deeply through analysis of context and language structure. This fact demonstrates that technology can act as a facilitator in complex learning processes. However, the role of lecturers is still needed to provide appropriate direction and interpretation of the material being studied (Annamalai et al., 2023).

Unlike other skills, listening learning still faces challenges in the implementation of *deep learning*. This is due to technological limitations in understanding variations in accents and cultural contexts within languages. Therefore, further development of speech processing technology is needed to improve the effectiveness of listening learning (Ahmed et al., 2024). These findings indicate that the implementation of *deep learning* still has limitations that need to be addressed. The integration of pedagogical aspects in the implementation of *deep learning* can be seen in how lecturers design learning activities. Problem-based learning designs have proven to be more effective in utilizing AI technology. In this approach, students are encouraged to actively seek solutions to given problems. *Deep learning technology* acts as a tool in the process of information retrieval and data analysis.

On the other hand, a collaborative learning approach also shows high relevance in this context. Although *deep learning technology* tends to be individualistic, its integration with collaborative learning can enhance social interaction among students. This is crucial for developing communication skills, the primary goal of English language learning. Thus, technology and pedagogy can complement each other in creating effective learning. Conceptually, the integration of

technology and pedagogy can be described as an interconnected system.



**Figure 1:** Deep Learning Integration Model in English Language Learning

This model shows that the success of *deep learning implementation* is determined not only by technology but also by the learning strategies used. Therefore, synergy between the two is needed to achieve optimal results. Based on the analysis, it was found that one of the key factors in the successful implementation of *deep learning* is the digital competence of lecturers. Lecturers who have a good understanding of technology tend to be better able to integrate it into learning. Conversely, limited digital competence can be a barrier to technology utilization. This demonstrates the importance of training and professional development for lecturers. Furthermore, infrastructure readiness is also a crucial factor in the implementation of *deep learning*. The availability of technological devices and adequate internet access are crucial for the success of AI-based learning. Field evidence shows that infrastructure inequality remains a barrier in some universities. Therefore, strong policy support is needed to address this issue (Mohammad et al., 2026).

Student learning motivation also plays a role in determining the effectiveness of *deep learning implementation*. Engaging and

interactive technology can increase student learning interest. However, without intrinsic motivation, technology use will not produce optimal results. This suggests that psychological factors also need to be considered in technology-based learning. In terms of evaluation, the use of *deep learning* allows for more objective and accurate assessments. AI systems can analyze student performance in detail and provide constructive feedback. However, this assessment still needs to be combined with subjective assessments from lecturers to obtain more comprehensive results (Corral-Montoya et al., 2022).

Further analysis shows that the implementation of *deep learning* also has the potential to enhance personalized learning. This technology can tailor learning materials to the needs and abilities of each student. This is a major advantage compared to conventional learning methods. However, the use of *deep learning* also poses ethical challenges, such as the potential for plagiarism and dependency on technology. Therefore, clear regulations are needed for the use of this technology. Lecturers need to set appropriate boundaries to ensure students continue to develop their abilities independently (Linden et al., 2025).

From a theoretical perspective, the integration of *deep learning* in English language learning can be explained through adaptive learning theory. This theory emphasizes the importance of tailoring learning to individual needs. In this case, technology plays a role as a tool for realizing adaptive and responsive learning. Furthermore, cognitive load theory is also relevant in explaining the implementation of *deep learning*. Technology can help reduce students' cognitive load by providing structured information. However, if not used appropriately, technology can actually increase cognitive load. Globally, the implementation of *deep learning* in English language learning has become a rapidly growing trend. Many countries have adopted this technology in their education systems. This indicates that *deep learning* has great potential to improve the quality of education (Hope et al., 2025).

Based on the existing findings, it can be concluded that the implementation of *deep learning* in English learning has great potential, but requires a holistic approach. The integration of technology and pedagogy is a key factor in determining learning success. Furthermore, the

results of this study also show that the success of *deep learning implementation* is not determined by a single factor, but rather the result of the interaction of various factors. Therefore, a systemic approach is needed in developing technology-based learning. The practical implication of this research is the need to develop a curriculum that systematically integrates *deep learning technology*. The curriculum must be designed in such a way as to maximize the potential of technology (Deore et al., 2025).

Training for lecturers is also crucial. Lecturers need to be equipped with adequate knowledge and skills in using *deep learning technology*. This will improve the overall quality of learning. Furthermore, it is necessary to develop policies that support the implementation of technology in education. These policies should cover aspects of infrastructure, training, and learning evaluation. In the context of further research, a more in-depth study is needed regarding the long-term impact of *deep learning implementation*. This is crucial to ensure the sustainability of technology use in education. The implementation of *deep learning* in English language learning is a strategic step in facing the challenges of education in the digital age. With the right integration of technology and pedagogy, English language learning can be more effective, adaptive, and relevant to the needs of the times.

### **To what extent does the implementation of deep learning contribute to improving the quality of students' English learning from the perspective of cognitive aspects and language skills?**

Literature studies have shown that the implementation of *deep learning* in English language learning in higher education has experienced significant growth in recent years (Liang et al., 2025). This transformation not only touches on technical aspects but also impacts a more adaptive learning structure. Analysis of various sources shows that this technology is able to expand access to a wider variety of learning resources. This provides an initial foundation for understanding the contribution of *deep learning* to learning quality. Concurrently, secondary empirical findings show that *deep learning* contributes to improving students' cognitive aspects. This technology enables students to engage in deeper thinking processes through data analysis and digital interactions. This process encourages the development of critical thinking

skills, one of the main indicators of modern learning (Linden et al., 2025).

Furthermore, the integration of *deep learning* into English language learning also impacts students' analytical abilities. Various studies show that students who use AI-based systems tend to be better able to systematically understand language structures. This is due to the presentation of material based on patterns and relevant contexts. In the learning context, *deep learning* acts as a tool that facilitates more complex information processing. Students not only receive information but also process and interpret data independently. This condition indicates a significant increase in cognitive capacity. Furthermore, the contribution of *deep learning* to cognitive aspects is also evident in students' reflective abilities. This technology provides feedback that allows students to independently evaluate their mistakes. This reflection process is an essential part of continuous learning (Raman et al., 2026).

On the other hand, English writing skills have significantly improved through the implementation of *deep learning*. The AI-based system is able to provide corrections to sentence structure, grammar, and vocabulary. This helps students gradually produce better writing. Furthermore, students' reading skills also show positive development. *Deep learning technology* can assist in text comprehension through deeper contextual analysis. This allows students to grasp the content of the reading more comprehensively. In the speaking aspect, the implementation of *deep learning* contributes through AI-based conversation simulations. Students can practice speaking without fear or social pressure. This increases their confidence in communicating in English (Kong & He, 2025).

Listening skills have also improved, although some challenges remain. Technology can provide a variety of audio formats, helping students understand different accents. However, limitations in interpreting cultural contexts remain a challenge. Pedagogically, the contribution of *deep learning* is strongly influenced by the learning strategies used. Problem-based and project-based approaches have proven to be more effective in utilizing this technology. Students are encouraged to be active participants in the learning process. In practice, the use of *deep learning* also increases student engagement. Interactive technology makes students more motivated to

learn, a crucial factor in improving the quality of learning (Belete & Alitasb, 2025).

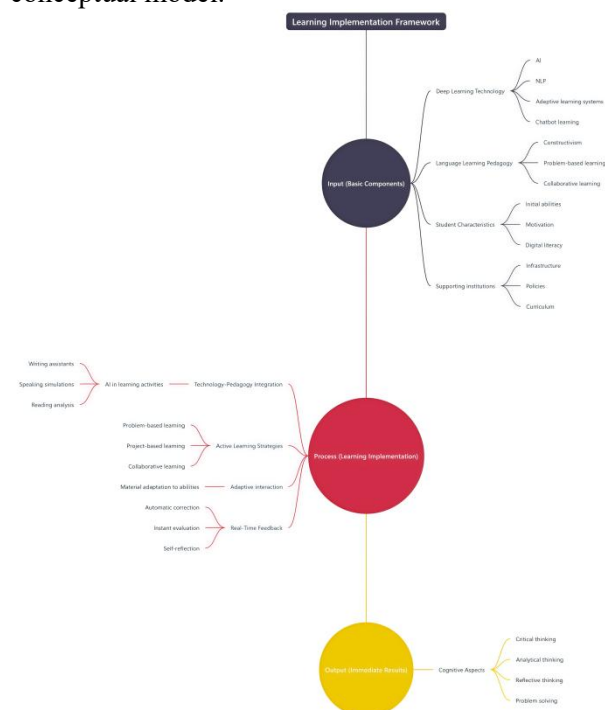
Based on secondary data analysis, it was found that *deep learning-based instruction* tends to be more personalized. The system is able to adapt the material to each student's individual abilities, providing a more effective learning experience. Furthermore, the contribution to cognitive aspects is also evident in problem-solving abilities. Students are trained to think systematically and logically in completing assignments. Technology helps provide relevant information to support this process. From a critical perspective, the implementation of *deep learning* does not always automatically have a positive impact. Its effectiveness depends heavily on how the technology is used in learning. Without the right pedagogical approach, its benefits are limited. Lecturers' digital competence is a determining factor in the success of *deep learning implementation*. Lecturers who are able to integrate technology well will produce more effective learning. Conversely, limited competence can become a barrier.

Infrastructure readiness also influences the contribution of technology to learning. The availability of devices and internet networks are key supporting factors (Kong & He, 2025). Without this support, optimal implementation of *deep learning is difficult*. In terms of learning motivation, *deep learning technology* can increase student interest. Interactivity and flexibility are key attractions in learning, resulting in increased learning engagement. In terms of evaluation, *deep learning* allows for more objective assessments. The system can analyze student performance in detail. However, the role of lecturers is still required to interpret the results. Regarding adaptive learning, this technology enables learning differentiation. Students with different abilities can learn at their own pace. This is a major advantage over conventional methods (Gamage et al., 2024).

From a theoretical perspective, the contribution of *deep learning* can be explained through constructivist learning theory. Students construct knowledge through interaction with technology. This process strengthens their understanding of the material. Globally, the use of *deep learning* in English language learning has shown positive results. Many educational institutions have adopted this technology, demonstrating its relevance in modern education. However, implementation in developing countries still faces various challenges. Limited resources

are a major obstacle. Therefore, adaptation strategies tailored to local conditions are needed. Analysis shows that the contribution of *deep learning* is multidimensional, impacting not only learning outcomes but also the learning process itself. This makes technology an integral part of education.

In the context of this research, the contribution of *deep learning* to cognitive aspects and language skills can be formulated in a conceptual model.



**Figure 2.** Synthesis of Deep Learning Implementation Model in English Language Learning

Considering the various findings, it is clear that successful implementation is not solely determined by technology. Human and environmental factors also play a crucial role. Therefore, a holistic approach is required. The integration of technology into English language learning needs to be systematically designed. The curriculum must be adapted to technological developments. This will increase learning effectiveness. Furthermore, training for lecturers is an urgent need. Lecturers need to be competent in using technology optimally. This will support the successful implementation of *deep learning*. The contribution of *deep learning* to students' English learning can be said to be significant, but it is contextual. This means that successful implementation is highly dependent on various supporting factors. Therefore, continuous

development is key to maximizing the benefits of this technology.

## CONCLUSIONS

1. The implementation of deep learning in English language learning for university students, from the perspective of integrating technological and pedagogical aspects, can be concluded. It has significant potential to improve the quality of learning when synergistically integrated between technological and pedagogical aspects. Deep learning technology can support more adaptive, personalized, and data-driven learning, particularly in improving language skills such as writing, reading, and speaking. However, the effectiveness of its implementation is not solely determined by technological sophistication but also depends heavily on pedagogical design, lecturers' digital competence, infrastructure readiness, and student motivation.
2. The implementation of deep learning contributes to improving the quality of English language learning for university students, from a cognitive and language skills perspective. Literature shows that the implementation of deep learning in learning significantly contributes to improving the quality of English language learning for university students, particularly in cognitive and language skills. From a cognitive perspective, this technology encourages critical, analytical, and reflective thinking, as well as problem-solving skills through adaptive and interactive learning presentations. Meanwhile, in terms of language skills, deep learning has been shown to support improved writing, reading, speaking, and listening skills through automated feedback, interactive simulations, and personalized learning materials. However, this level of contribution is not absolute and is influenced by pedagogical integration, lecturers' digital competencies, infrastructure readiness, and student motivation.

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