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Teacher Preparedness and Technological Literacy in AI-Integrated Classroom: Indonesian EFL Teachers' Experience

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Abstract:
This study investigates teacher preparedness and technological literacy in an AI-integrated classroom, particularly in an English as a Foreign Language (EFL) setting. This investigation employed a mixed-methods approach, utilizing open-ended questionnaires, observations, and document analysis to collect comprehensive qualitative data regarding Indonesian EFL teachers' perspectives and experiences of AI implementation in EFL classrooms. Descriptive statistical analysis was used to compare EFL students' reading, writing, speaking, and listening outcomes with and without teacher preparedness and technological literacy. These findings highlight the crucial role of teacher preparedness and technological competence in successfully adopting AI for educational purposes. Key considerations include grasping the AI fundamentals, leveraging AI tools, addressing ethical issues, providing professional development opportunities, and ensuring adequate resources. Although AI offers potential advantages, obstacles, such as inadequate training, resource limitations, and moral dilemmas, remain. This study emphasizes the need for on-going teacher education, infrastructure support, and curriculum modifications to fully exploit AI's potential to enhance language instruction. Future studies should explore AI's role in language assessment and personalized learning approaches.
Keywords: artificial intelligence, pedagogy, professional development, teacher preparedness, technological literacy

I. INTRODUCTION

In the era of the Fifth Industrial Revolution, generative artificial intelligence (AI) is transforming educational institutions and learning environments at an unprecedented pace (Akpan et al., 2024; Budhwar et al., 2023; Mariani & Dwivedi, 2024). As noted by Ooi et al. (2023) and Wang et al. (2024), this phenomenon requires that educators develop two essential competencies: preparedness and technological literacy (Durst et al., 2023; Giacci, 2023; Güner & Aslan, 2023; Hathaway et al., 2024; Smith et al., 2024).

Livers et al. (2021) and Lieung et al., 2019 highlighted the importance of preparedness for effective teaching and found a strong correlation between educators' sense of readiness and professional efficacy. They noted that coursework and practical training, which enhance instructors' confidence and pedagogical skills, significantly influence their knowledge acquisition and understanding. Similarly, Scherer et al. (2023) and Ardiningtyas et al (2023) found that teacher preparation for online instruction is linked to student experience levels, with more experienced students benefiting more from better-prepared instructors.

Hasyim et al. (2024) and Nurhikmah et al., (2024) emphasized that teacher preparedness is crucial for online teaching success and identified five key skills in the digital era: digital literacy, self-efficacy, school management, infrastructure, and technological pedagogical content knowledge (Butarbutar, 2024a, b; Bueno et al., 2023; Butarbutar et al., 2021; Deng & Zhang, 2023; Jammeh et al., 2024; Kulaksız & Karaca, 2023).

Familoni and Onyebuchi (2024) similarly emphasize the significance of technical literacy in the digital era, noting its critical role in professional contexts. They posited that technical literacy has become essential for success in our technology-driven society, particularly given the rapid pace of technological advancement. The integration of AI in educational settings, specifically in English as a Foreign Language (EFL) classrooms, enhances educators' capacity to cultivate students' critical problem-solving skills (Ayotunde et al., 2023; Darwin et al., 2024; Luo & Qiu, 2024; Liu et al., 2023; Zhai & Wibowo, 2023). Instructors with higher levels of AI readiness demonstrated a greater propensity to adopt AI in their pedagogical approaches. Zhang and Villanueva (2023) contend that technological proficiency and rigorous training are fundamental to effectively incorporating teacher preparedness into educational systems. Yue et al. (2024) further assert that successful AI implementation in education necessitates teachers to possess Technological Pedagogical Content Knowledge (TPACK) and maintain a positive disposition.

In Indonesia, the application of AI in education has increased notably in recent years (Reza et al., 2020). While the use of AI in education is still emerging, its potential to enhance the learning process is substantial. A significant development is the implementation of AI technologies such as ChatGPT in EFL classes, facilitating a more personalized and adaptive learning experience tailored to individual student needs (Butarbutar, 2024a; Leba & Butarbutar, 2024).

However, EFL instructors in Indonesia currently lack sufficient preparation to address the widespread presence of AI in education, particularly regarding its integration into EFL classrooms. Additional challenges included inadequate teacher training, insufficient education, and limited institutional resources. Furthermore, there is a dearth of empirical research on how teacher readiness and technological proficiency impact EFL classrooms and student skill development (Butarbutar & Gonzalez Vallejo, 2025). This study aims to address

these gaps by providing practical guidance for teachers to prepare for AI integration in their EFL classrooms and respond to special calls for papers on language and educational topics.

Moreover, the current study suggests that effective AI integration into EFL classrooms necessitates educators who are well-prepared and technologically proficient. This involves: (1) understanding the fundamentals of AI, (2) effectively utilizing AI-based tools, (3) addressing ethical considerations, (4) engaging in continuous learning and skill development, and (5) ensuring appropriate resource allocation. Additionally, teacher readiness and technological proficiency significantly affected EFL students' learning outcomes. However, educators face various challenges when implementing AI in EFL settings, including (a) institutional support, (b) pedagogical challenges, (c) ethical considerations, and (d) technical challenges.

To address the aforementioned research gaps and to investigate the alignment between Indonesian EFL teachers' experiences and their preparedness and technological literacy in AI-integrated classrooms, this study was designed to address the following research questions:

1. What is teacher preparedness and technological literacy in AI-integrated EFL classrooms?
2. How do teachers' preparedness and technological literacy in AI affect students' outcomes?
3. What challenges do teachers face when preparing AI-integrated EFL classrooms?

Literature review

Teacher preparedness for Integrating-AI

Examining teacher preparedness offers crucial insights into improving educators' readiness to establish effective learning environments. Acikgoz et al. (2023), Sungur-Gül and Ateş (2021), and Wang et al. (2024) cite Ajzen's (1991) Theory of Planned Behavior (TPB), which suggests that individual actions are influenced by personal beliefs regarding available resources and opportunities. Consequently, teachers are more likely to implement AI in EFL instruction when they perceive that institutional infrastructure and facilities support such integration. This theory also proposes that educators are more inclined to incorporate AI into EFL classrooms when they anticipate a positive effect on student outcomes (Alhalangy & AbdAlgane, 2023; Butarbutar, 2024a; Du & Gao, 2022; Mohamed, 2024; Zhang et al., 2024).

Teacher readiness is defined as educators' preparedness and ability to incorporate artificial intelligence (AI) technologies into their teaching methods. This concept encompasses knowledge and skills, curriculum integration, pedagogical adjustments, institutional backing, and infrastructure (Abulibdeh et al., 2024; Ali et al., 2023; Ayanwale et al., 2024; Chounta et al., 2022; Yue et al., 2024).

Fundi et al. (2024) assert that integrating AI education into teacher training programs is essential for equipping educators to teach AI effectively. They also stressed the significant impact that pre-service teachers can have on the development of robust professional AI training initiatives. Kaczorowski et al. (2024) explored the use of prompting techniques to assist pre-service teachers in crafting AI-enhanced lesson plans for special education. Their study underscored the need to avoid simply copying and pasting when utilizing ChatGPT for lesson planning. Instead, candidate teachers are urged to create and incorporate AI into their curricula by generating tailored content that meets their students' unique needs, prior knowledge, and learning styles. This method facilitates a personalized and efficient learning

experience for students with special needs. Moreover, the process of designing AI-assisted lesson plans provides an excellent opportunity for aspiring educators to enhance their critical thinking and analytical skills during lesson preparation.

According to Wang et al. (2023), AI preparedness in the educational sector refers to educators' capacity to successfully integrate artificial intelligence, encompassing aspects such as cognitive abilities, knowledge, anticipation, and ethical considerations. Their research indicated that teachers with greater expertise in this domain demonstrated improved proficiency in utilizing artificial intelligence in educational contexts.

Technological literacy

Technological literacy (TL) is defined as the capacity to comprehend, utilize, manage, and evaluate technology across diverse contexts (Chiu et al., 2020, 2024; Getenet et al., 2024; Jang et al., 2021; Stolpe & Hallström, 2024; Nikou et al., 2022; Yeşilyurt & Vezne, 2023). It encompasses the skills and knowledge necessary to navigate tools ranging from basic computer usage to advanced AI systems. It is regarded as an essential 21st-century competency for addressing the rapid pace of technological advancements (Butarbutar et al., 2023; Ezeudoka & Fan, 2024).

Within educational settings, TL is crucial for students' proficiency in utilizing tools, such as learning management systems (LMS), including Edmodo, to enhance learning outcomes (Hamidi et al., 2020; Simon et al., 2024; Unal & Uzun, 2021). This study highlights TL as encompassing not only technical skills, but also an awareness of ethical and societal impacts. A technologically literate individual is capable of recognizing the potential and limitations of digital tools while understanding their ethical responsibilities. As a subset of TL, AI literacy is vital for adapting to AI advancements and effectively integrating these tools into workflows and processes. Awareness of AI's implications of AI is particularly significant for educators and students (Almatrafi et al. 2024). In summary, TL involves the ability to navigate diverse technologies from practical applications to ethical considerations. AI literacy, integral to TL, plays a pivotal role in modern education and professional environments by fostering personalized learning, enhancing engagement, and addressing challenges, such as resource constraints, ethical issues, and insufficient training.

Research Method

This study employed a combination of open-ended questionnaires, observations, and surveys to collect comprehensive qualitative data to address the research questions presented in the introduction. The goal was to gain detailed insights into the participants' views and experiences regarding AI integration in EFL classrooms. Additionally, the study used descriptive statistical analysis to assess how teachers' readiness and technological competence affected EFL students' outcomes. To ensure ethical compliance in research involving human subjects, the investigators submitted their research proposals to Musamus Merauke University's Institutional Review Board (IRB) for review and approval before initiating the study. This step ensured that ethical standards were upheld throughout the research process.

Respondent demographic information

In accordance with the aims of the study, respondents were selected through purposive sampling. Consequently, the researchers chose EFL teachers who expressed interest in integrating AI into their classrooms. However, these teachers possess limited expertise and training in the institutional implementation of these technologies. The profiles are listed in Table 1.

Table 1. Respondent demographic information

Identity	Number of respondents (N=50)	Percentage (%)
Age		
20-30	16	32
31-40	30	60
41-50	3	6
51-60	1	2
Gender		
Male	20	40
Female	30	60
Years of teaching experience		
0-5 years	26	52
6-10 years	12	24
11-15 years	6	12
16-20 years	5	10
Above 21year	1	2
Educational qualification		
Bachelor's Degree	20	40
Master's Degree	24	48
Doctorate (PhD)	1	2
Other (Please specify)	5	10
Current teaching level		
Primary School	10	20
Secondary School	20	40
Tertiary/University	20	40
Adult Education	0	
AI tools in EFL classroom		
(ChatGPT, ELSA Speak)	20	50
(Grammarly, Quillbot)	20	50

Technique of collecting and analysing data

To gather data, the research team administered an open-ended questionnaire to 50 Indonesian EFL instructors with varying experience levels in classroom AI implementation. The questionnaire comprised five questions with response options of "do not understand, neutral, somewhat understand, and very understand." An open-ended question, "What are your challenges during AI integration into your EFL classroom?" was included. This questionnaire was generated using Google Forms, and its link was disseminated via

WhatsApp Group (WAG). The researchers employed this method to facilitate an efficient data collection process.

This study examines the impact of teacher preparedness and technological literacy in AI on students' EFL achievement. The researchers employed document analysis to collect data, specifically analyzing students' scores by comparing them from the beginning to the end of the semester. In this investigation, the beginning of the semester represented a period when teachers had not yet integrated AI into their classrooms, whereas the end of the semester represented a period when they had already incorporated AI into their instructional practices.

Furthermore, the researchers selected documents from one educator who taught a class of 20 students, considering that she possessed extensive knowledge of technological literacy components. These components encompass (1) understanding AI fundamentals, (2) utilizing AI tools for EFL, (3) ethical considerations, (4) training and professional development, and (5) resource allocation. To the researchers' knowledge, they did not conduct any intervention or experiment during this study; rather, they analysed the students' document scores.

To corroborate the data from the document analysis, the researchers conducted observations in one of the EFL classrooms. This class was selected based on the instructor's comprehension of integrating AI into the educational environment. According to the questionnaire data, she was the sole instructor categorized as "very understand" in the four components of teacher preparedness and technological literacy. Consequently, the class was observed for utilizing AI tools in the learning process and student engagement.

The results of the open-ended questionnaire were analyzed using a mixed-method approach. This methodology aligned with an analysis of teacher preparedness and technological literacy, as well as students' final scores, utilizing descriptive statistics. Simultaneously, one open-ended question regarding the challenges educators face in integrating AI into EFL classrooms underwent qualitative analysis. The identified challenges were categorized into four distinct themes: (1) institutional support; (2) pedagogical challenges; (3) ethical issues; and (4) technical challenges as can be seen in Figure 2.

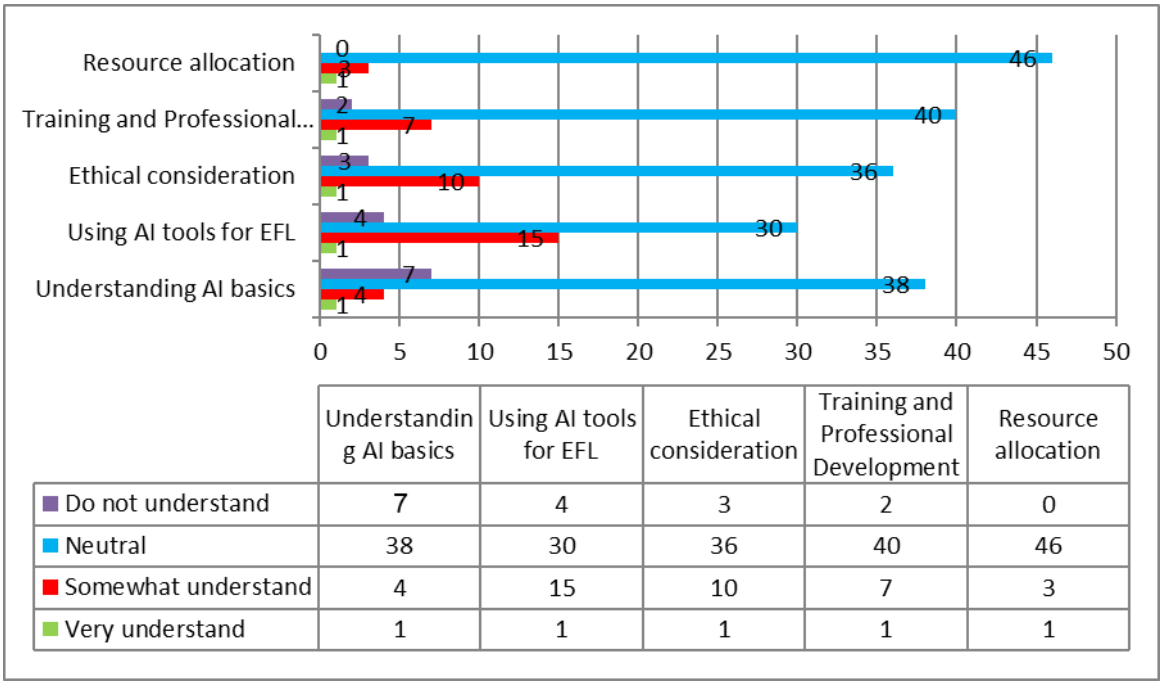
Trustworthiness

Ensuring the credibility, reliability, and significance of these results are of paramount importance (Coleman, 2022). In this context, researchers have employed triangulation techniques for data and results. Data were triangulated using three distinct sources: open-ended questionnaires, document analysis, and class observations. Furthermore, this study implemented researcher triangulation involving multiple experienced researchers to verify and corroborate the results. This approach aims to mitigate individual bias during data analysis and interpretation, as noted by Ahmed (2024) that trustworthiness is enhanced through the accurate representation of studied experiences, viewpoints, or phenomena.

Consequently, this study utilized a member-checking approach to confirm the findings. Additionally, the researchers presented the chosen results to teachers for authentication. The aim was to secure teachers' verification and endorsement of aid in drawing conclusions.

Results

In response to the first research question, teacher preparedness and technological literacy in AI-integrated EFL classrooms were categorized into five components: (1) understanding AI fundamentals, (2) utilizing AI tools, (3) ethical considerations, (4) training and professional development, and (5) resource allocation. The assessment of preparedness is shown in Figure 1.



	Understanding AI basics	Using AI tools for EFL	Ethical consideration	Training and Professional Development	Resource allocation
Do not understand	7	4	3	2	0
Neutral	38	30	36	40	46
Somewhat understand	4	15	10	7	3
Very understand	1	1	1	1	1

Figure 1. Teacher preparedness and technological literacy

The analysis of the second research question revealed that students' EFL performance was significantly affected by their level of teacher preparation and technological proficiency. This influence was notably observed across four primary areas of EFL competence: reading, speaking, listening, and writing. The students demonstrated better results when taught by instructors with higher levels of preparedness and technological literacy. This observation indicates that comprehensive teacher training and effective use of technology in language education are crucial elements in enhancing students' overall EFL skills. The results of student performance are presented in Tables 2 and 3.

Table 2. Students' pre-test score

EFL skills score	Students' number	Mean	Standard deviation
Reading	20	6.035	0.139
Writing	20	6.085	0.245
Listening	20	5.165	0.351
Speaking	20	6.050	0.153

Table 2 displays students' scores before teachers integrate AI into EFL classroom activities. At the beginning of the semester, assuming that teachers were not prepared for artificial intelligence, the reading scores were as follows: 16 students (80%) scored six, while the remaining four students (5% each) achieved scores of 5.8, 6.1, 6.3, and 6.5, respectively. For

writing scores, 17 students (85%) received a 6, and the other three students (5% each) scored 6.2, 6.5, and 7. In terms of listening skills, 17 students (85%) scored 5, one student (5%) scored 5, another (5%) scored 5.5, and one more (5%) received 5.8. Overall, only two students (10%) attained a score of 6.5, while the other 18 (90%) scored 6 in speaking skills.

Table 3. Students' post-test score

EFL skills score	Students' number	Mean	Standard deviation
Reading	20	8.335	0.439
Writing	20	8.440	0.572
Listening	20	7.010	0.522
Speaking	20	8.275	0.443

Table 3 displays students' scores after teachers integrated AI into EFL classroom activities. At the end of the semester, assuming that teachers had prepared for artificial intelligence, the reading scores were as follows: 12 (60%) scored 8, four achieved 9, and individual students attained scores of 8.5, 8.6, 8.7, and 8.9, each representing 5% of the cohort. In writing, nine students scored 9, and eight scored 8. Additionally, three students (5%) received scores ranging from 8.5 8.7. Regarding listening skills, 20% (four students) improved with a score of 8, 60% (12 students) achieved 7, and individual students (5% each) scored 6.8, 6.7, 6.5, and 6. In the speaking assessment, 25% (five students) attained a score of 9, one student (5%) reached 8.5, and the majority (70% or 14 students) scored 8.

To support our findings, we used a t-test to evaluate the effect of teachers' preparedness and technological literacy on student outcomes. The analysis was performed using Microsoft Excel (Table 4).

Table 4. t-test

t-Test: Paired Two Sample for Means		
	pre-test	post-test
Mean	6.035	8.335
Variance	0.019237	0.192921
Observations	20	20
Pearson Correlation	-0.08164	
Hypothesized Mean Difference	0	
df	19	
t Stat	-21.8255	
P(T<=t) one-tail	3.24E-15	
t Critical one-tail	1.729133	
P(T<=t) two-tail	6.47E-15	
t Critical two-tail	2.093024	

Table 4 shows the results of the t-test: two paired samples for means, with P-value of P ($T \leq t$) one-tail: 3.23579E-15 and P ($T \leq t$) two-tail: 6.47159E-15. These exceptionally small p-values indicate high level of statistical significance. The results, demonstrated by a substantial t-statistic and a minimal P-value, indicate a statistically significant difference

between pre-test and post-test scores. This finding suggests that teachers' preparedness and technological literacy strongly positively impact student outcomes.

Addressing the third research question, this investigation uncovered various obstacles faced by teachers when setting up AI-enhanced EFL classrooms such as institutional support, pedagogical challenges, ethical issue, and technical challenges, as shown in Figure 2. From a qualitative standpoint, these factors affect teacher effectiveness, student participation, and the overall learning atmosphere. Nevertheless, they may pose difficulties that require continuous assistance and skill enhancement. Tackling these issues demands a comprehensive strategy that encompasses instructional training, organizational backing, and a forward-thinking approach to integrate AI technologies into EFL curricula and teaching methods.

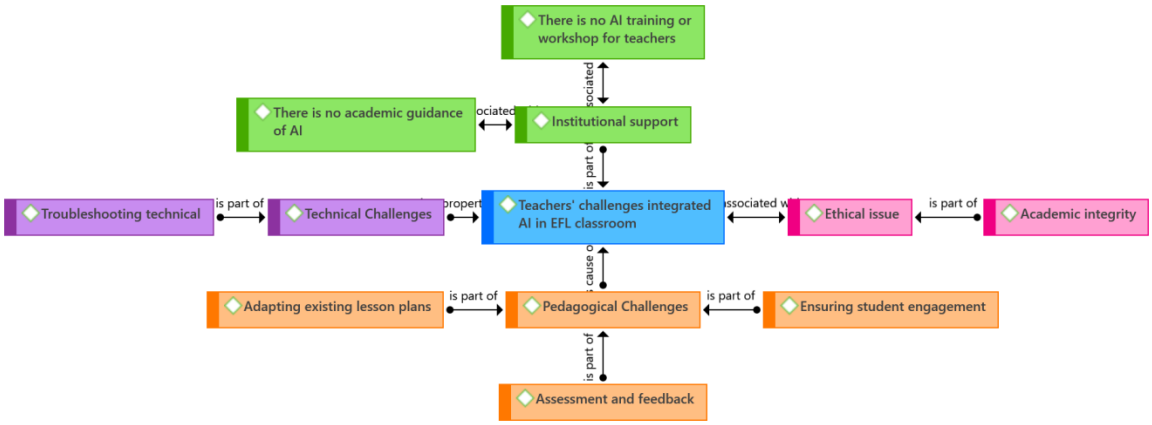


Figure 2. Teachers challenges in integrating AI with EFL classroom

Discussion

The findings from the initial query investigation suggest that several factors influence teacher readiness and technological proficiency in EFL classrooms that incorporate AI. These factors include the comprehension of AI basics, proficiency in AI tool usage, recognition of ethical implications, availability of professional growth opportunities, and appropriate allocation of resources. Each of these elements plays a vital role in empowering educators to maximize AI's potential to enhance language acquisition. By addressing these aspects, educational institutions can successfully implement AI in EFL settings, thus yielding advantages for both instructors and learners. In addition, a paradigm shift is essential for effective integration, perceiving AI as a collaborative instrument (Butarbutar & Gonzalez Valleo, 2025, Ardiningtiyas et al., 2023) that complements human instruction. Through continuous support and resource provision, teachers can fully exploit AI to improve learning outcomes in EFL environments while simultaneously upholding ethical principles and cultivating students' critical thinking abilities.

Our study aligns with the research of Yetkin & Özer-Altınkaya (2024), which underscores the importance of pre-service EFL teachers' self-assurance in understanding and implementing artificial intelligence within language-teaching settings as a key factor in developing their future abilities. Drawing on Ajzen's (1991) Theory of Planned Behavior (TPB), as referenced by Sungur-Gül & Ateş (2021), confidence is vital for nurturing future competencies. Our research corresponds to this theory, suggesting that teachers can gain a

more thorough understanding of the concepts necessary for creating successful AI-integrated EFL classrooms. This is directly related to the perceived behavioral control component of Ajzen's TPB. When educators feel highly confident about their capacity to utilize AI (high perceived control), they are more inclined to develop the intention to incorporate AI into their teaching methods. However, a lack of confidence may lead to perceived lower control, potentially resulting in reluctance or unwillingness to adopt AI tools (Cappuccio et al., 2024; Wu et al., 2024).

The results also support the Technology Acceptance Model, which suggests that the perceived usefulness and simplicity of technology usage affect users' readiness to embrace it (Liu & Ma, 2024; Ma et al., 2024; Saif et al., 2024; Solomovich & Abraham, 2024). EFL teachers who have strong faith in AI's capabilities are more likely to integrate it into their teaching practices, viewing these tools as advantageous and easy to use. According to the Technology Acceptance Model, when educators believe AI will improve teaching and learning processes, they are more likely to implement it in their instructional approaches, potentially resulting in better student outcomes, as shown in this study. In this instance, the instructor believed that incorporating an AI debater would improve students' debating abilities because they strongly agreed with comprehending AI basics and employing AI tools. Moreover, instructors assisted the students by developing prompt engineering guidelines.

Despite their strong belief in incorporating AI into EFL classroom curricula, educators in this study identified two main obstacles: the need for training and professional development (TPD) and the allocation of resources during lesson planning. At the time this paper was written, teachers primarily relied on online sources to enhance their TL abilities independently.

The analysis of the second research question revealed a notable impact of educators' readiness and digital competence on EFL learners' performance. This effect was particularly pronounced for reading, speaking, listening, and writing abilities. Instructors with superior levels of preparation and technological proficiency correlated with enhanced student results. Our findings suggest that boosting overall EFL competence requires effective teacher education and the incorporation of technology in language teaching. Table 1 displays students' initial EFL scores. Eighty percent (16 students) achieved a score of six, while 5% (one student) scored 5.8. Regarding writing, 85% (17 students) scored 6; one attained 6.2, another 6.5, and one reached 7. Eighty-five percent (17 students) scored 5, one achieved 5.5, another 5.8, and 10% (two students) scored 6.5. Table 2 shows the results of AI implementation in the classroom. Sixty percent (12 students) scored eight, four achieved nine, one scored 8.5, another 8.6, one more 8.7, and one reached 8.9. Twenty percent (four students) scored 8, 12 achieved 7, and one scored 6.8, 6.7, and 6.5, respectively. Twenty-five percent (five students) scored nine, one achieved 8.5, and 70% (14 students) scored eight.

Our position on the aforementioned results is in agreement with Hasyim et al.'s (2024) study, which suggests that better teacher preparation for online teaching correlates with improved student outcomes in suburban regions. However, they recommend enhancing teachers' literacy skills through continuous professional development initiatives. We also strongly support the views of Kim & Tawfik (2023), Patrick et al. (2023); Tan et al. (2023) regarding the necessity of students' involvement in hands-on problem-solving exercises. In this study, teachers incorporated AI language learning tools such as AI-Debater, QuillBot, and Google Translate into their lesson plans, engaging students in project-based learning. This approach led to improved EFL results among students. We validated that instructors with a stronger faith in AI are more inclined to integrate it into their EFL classroom projects.

The research findings indicate that various factors significantly influence teachers' perceived readiness to implement AI in EFL classrooms. These factors include a combination of pedagogical methods, support and resources from institutions, evaluation and feedback mechanisms, and technological proficiency. This finding aligns with the literature review by Crompton et al. (2024), which highlights the skill deficiencies faced by EFL teachers, subsequently affecting students' language learning and mastery. Furthermore, our results support the arguments presented by Butarbutar (2024b) and Villanueva (2023), emphasizing the importance of AI preparedness and digital literacy in relation to teacher training and professional growth. Teachers who received comprehensive training in AI and digital competencies demonstrated higher levels of expertise in technology-enhanced teaching practice.

Conclusion and Implication

In conclusion, examining Indonesian higher education is crucial for understanding the significance of digital and technological skills in effective modern teaching. The successful implementation of AI in education depends largely on teachers' preparedness and technological proficiency, which can result in tailored learning experiences, improved classroom management, and improved student outcomes. Educator preparation involved (1) understanding AI fundamentals, (2) employing AI-powered tools, (3) addressing ethical concerns, (4) engaging in training and professional development, and (5) obtaining necessary resources. These findings suggest that artificial intelligence (AI) has significant potential to enhance both affective and cognitive abilities, as well as overall language acquisition. Within the context of EFL, it is imperative to modernize curricula to effectively integrate AI technologies (Lai et al., 2024). Advanced tools such as ChatGPT can assist students in developing their reading, writing, speaking, and listening skills. Educators' readiness and technological proficiency are crucial to the successful integration of AI into educational settings, necessitating continuous professional development programs that focus on AI fundamentals, ethical considerations, and optimal usage.

This study underscores the necessity of adequate infrastructure and resources to support effective AI implementation, particularly in Indonesia, where challenges such as insufficient training and resource constraints persist. Educational institutions should invest in technological support to address these issues. Moreover, personalized learning methods enabled by AI can enhance student engagement and improve educational outcomes. Future research should investigate AI applications across diverse geographical and cultural contexts to better understand its role in global language learning. Ensuring that instructors possess technological literacy significantly enhances their impact on EFL students' performance, particularly their speaking, reading, listening, and writing skills. This underscores the importance of teacher preparedness and effective technological integration for improving overall EFL competence.

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