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BRIDGING KNOWLEDGE AND ACADEMIC INTEGRITY: AI INTEGRATION FOR TPACK DEVELOPMENT IN EFL TEACHER EDUCATION PROGRAM

I Putu Indra Kusuma[1*], Luh Gd Rahayu Budiarta[2], Anak Agung Putri Maharani[3]
[1, 2]English Language Education, Universitas Pendidikan Ganesha, Indonesia
[3]Master of English Language Education Study Program, Universitas Mahasaraswati Denpasar
indra.kusuma@undiksha.ac.id[1], rahayu.budiarta@undiksha.ac.id[2], aamaharani@unmas.ac.id[3]
*correspondence: indra.kusuma@undiksha.ac.id
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Abstract
Recent research indicates that generative artificial intelligence (GenAI) such as ChatGPT has great potentials to support English as a foreign language (EFL) preservice teachers (PSTs) to develop their technological pedagogical content knowledge (TPACK) during their studies in teacher education programs (TEPs). How these PSTs view academic integrity while using GenAI and apply it for TPACK development are still unknown. Looking at the above gaps, this study aimed at exploring how EFL PSTs use GenAI to develop their TPACK and perceived academic integrity. This study recruited eight EFL PSTs in an Indonesian public education university using a basic qualitative methodology. This study employed semi-structured interviews and researchers' notes to collect the data. The data in this work was analyzed using inductive thematic analysis. The results revealed that participants used AI for language skill development and for content creation as well as task assistance. The results also showed that they knew the potential risks of GenAI on academic integrity, had their own strategies for maintaining academic integrity when using GenAI, and had good impressions of academic integrity in AI-assisted learning. This study drew several theoretical and practical implications to support the application of GenAI in TEPs.

Keywords: academic integrity, artificial intelligence, EFL preservice teachers, TPACK

Introduction
The rapid rise of GenAI tools has brought about a new era of possibilities and challenges for educators. For example, the launch of ChatGPT as a new generative AI chatbots has caught educators' attention (Hong, 2023). GenAI can produce written content in the target language, converse interactively with users, and translate a user's native language into a preferred target language (Cotton et al.,

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2023). It suggests that GenAI can seriously disrupt English language teaching (Farrokhnia et al., 2023; Kohnke et al., 2023). Maximizing these capabilities in English language teaching while reducing any potential drawbacks requires an understanding of how to use them pedagogically and ethically. However, the use of AI can also raise ethical concerns, including risks of academic dishonesty, over-reliance on AI tools, and inequitable access to technology, which could exacerbate educational disparities.

Despite the concerns, AI holds great potential for transforming language education by supporting teachers' professional development, particularly for EFL PSTs. EFL PSTs are known as novice and often lack teaching experience using technology (Kusuma et al., 2024). They are expected to have in-depth knowledge of English contents and pedagogical knowledge through TPACK Framework, a framework that gives teachers enough knowledge to use technology to teach a subject matter (Koehler & Mishra, 2005; Mishra & Koehler, 2006; Petko et al., 2024). GenAI has revolutionized language learning with its various potentials (Gonulal, 2021; Liang et al., 2021; Waer, 2021), such as serving as a digital dictionary (Kohnke et al., 2023), virtual tutor (Huang et al., 2023; Kohnke et al., 2025), translation tool (Baskara & Mukarto, 2023; Tsai, 2022), learning and assessment design (Kusuma et al., 2024; Lo, 2025), evaluating written text (Huang et al., 2023), and giving feedback (Rad et al., 2023). Therefore, with its diverse functionalities, GenAI holds great promise for empowering EFL PSTs to develop integrated TPACK, ultimately enhancing their readiness for effective and innovative language instruction. For example, GenAI can help supporting EFL PSTs during designing lesson plans and assessments (Kusuma et al., 2024). While GenAI offers great promise for empowering EFL PSTs to develop integrated TPACK and enhance their readiness for effective instruction, its application is not without significant challenges.

One of the challenges being faced is the ethical concerns, particularly regarding academic integrity. The application of AI often presents moral dilemmas during its usage (Nikolic et al., 2024). A growing number of studies have been devoted to revealing that GenAI can contribute to unethical academic practices, such as producing texts that are not original work (Farrokhnia et al., 2023), making it easier for users to complete assignments without going through the learning process (Chaudhry et al., 2023), and providing false references (Cotton et al., 2023). Promoting ethical awareness and academic integrity is crucial to encouraging the critical and responsible use of AI (Celik, 2023), especially among EFL PSTs who will shape future English educational practices.

Recent studies indicate that EFL PSTs increasingly utilize GenAI tools, primarily during teaching practicums, to enhance lesson planning, material development, and classroom delivery, engaging TPACK elements across planning, implementation, and reflection phases (Kusuma et al., 2024; Wulandari & Purnamaningwulan, 2024). However, the limited exploration of how these GenAI tools foster TPACK growth highlights the need for the present study to investigate these dynamics, contributing to a deeper understanding of technology integration in teacher education. Furthermore, little is known about how EFL PSTs view academic integrity when utilizing GenAI, a problem that is becoming more pertinent as GenAI tools in education have recently gained popularity. Meanwhile, the growing adoption of GenAI by English teachers highlights the need for deeper

understanding of its implications for teacher learning and ethics. Without a deeper understanding of the areas mentioned above, TEPs risk graduating teachers who are unprepared to both harness the full potential of GenAI and guide their own students toward its responsible use. To address these gaps, this study aims to explore how EFL PSTs develop their TPACK and perceive academic integrity in the context of GenAI usage. The following overarching research questions were formulated to guide this inquiry:

1. In what ways do English as a foreign language preservice teachers use generative Artificial Intelligence for their Technological Pedagogical Content Knowledge development?
2. To what extent do EFL preservice teachers perceive issues of academic integrity in the use of generative AI?

Literature Review

EFL preservice teachers and TPACK

Preservice teachers are novice and often face issues related to teaching. Several studies suggest that the issues commonly faced by PSTs are time management (Salinas & Ayala, 2018), gaps between pedagogical knowledge and practical skills (Salazar Noguera & McCluskey, 2017), communication, and classroom management (Chasanah & Sumardi, 2022). However, If TEPs can provide them with essential pedagogical content knowledge (Kusuma, 2022a), PSTs may have the foundational knowledge necessary for effective teaching (Batane & Ngwako, 2017). In addition, by engaging in real-world classroom experiences (Altalhab et al., 2021), PSTs can apply theoretical concepts, enhance their instructional skills, and cultivate professional competencies crucial for their teaching careers (Safari, 2020). Therefore, TEPs play a vital role in shaping well-prepared and competent educators (Altalhab et al., 2021; Kusuma, 2022a).

Although EFL PSTs may initially lack teaching experience and pedagogical skills, research indicates that they are adept at integrating technology into their instructional practices. For example, Park and Son (2020) found that EFL PSTs in Hong Kong utilized various web resources and software to support their teaching. Similarly, Fathi and Ebadi (2020) reported that EFL PSTs in Iran leveraged platforms such as Edu-cloud, online documents, interaction tools, and presentation devices. Interestingly, studies have also shown that EFL PSTs have disrupted social media for English teaching (Akayoglu et al., 2020). Also, previous studies indicate that EFL PSTs are implementing various technology tools into their teaching (Kusuma, 2022a, 2022b, 2022c). The fact that they are digital natives may be the cause of this trend (Park & Son, 2020) or maybe TPACK they acquire during their teacher education programs influence the technology integration in teaching (Habibi et al., 2020), which prepares them to effectively integrate technology into their lessons.

In order to give preservice teachers the skills they need to successfully incorporate technology into their teaching practices, many TEPs around the world have included the TPACK framework into their curricula (Kusuma, 2022a; Yüksel & Kavanoz, 2011). TPACK framework is developed based on Pedagogical Content Knowledge framework that was developed by Shulman (1986). This framework denotes the knowledge of teaching a subject matter to strengthen students' learning (Shulman, 1986). TPACK framework extends the Shulman's framework by adding

a technology domain. This extended framework emphasizes the needs of incorporating technology into the lessons (Koehler & Mishra, 2005; Mishra & Koehler, 2006; Petko et al., 2024). TPACK consists of seven domains as the interplay among technology, pedagogy, and content. Those seven dimensions are content knowledge, technology knowledge, pedagogy knowledge, technological content knowledge, technological pedagogical knowledge, pedagogical content knowledge, and TPACK (Koehler & Mishra, 2005; Mishra & Koehler, 2006; Petko et al., 2024).

Moreover, TPACK is flexible and can be adapted to different situations, tools, and pedagogical approaches (Celik, 2023; Koehler & Mishra, 2009). Studies have shown its applicability across various settings and educational levels. For instance, it has been used to foster 21st-century skills such as teamwork and critical thinking (Drajati et al., 2021), applied in higher education contexts (Bachy, 2015), and modified for early childhood education by integrating ecological aspects into instruction (Yang & Dong, 2024). More recently, TPACK has also been expanded to include AI, equipping teachers with the knowledge to integrate AI into lessons in an ethical manner (Celik, 2023).

A growing body of research has investigated how TPACK supports teachers' efficacy in using technology for teaching, yet the results remain inconsistent. Habibi et al. (2020) conducted a study with language teachers and found that the TPACK framework guided the integration of information and communication technology during teaching practice. Kusuma (2022b) also investigated the role of TPACK in EFL preservice teachers' teaching practices and reported that the framework helped participants develop sufficient knowledge, skills, and awareness for using technology when implementing flipped classrooms in their teaching practicums. In contrast, Sulaimani et al. (2017) showed that in-house CALL teacher professional development with a TPACK framework improved teachers' knowledge but failed to help them apply technology effectively in EFL classrooms. Similarly, Joo et al. (2018) reported that TPACK influenced teachers' perceived ease of use and perceived usefulness of technology but did not shape their intention to adopt it in practice. These mixed findings suggest that while TPACK contributes to teachers' technological understanding, more research is needed to explore how it translates into consistent and sustainable classroom practices.

Artificial intelligence, TPACK development, and academic integrity

Artificial intelligence is a term that first appeared in 1956 (Abramowitz & Antonenko, 2022; Deng & Lin, 2022). It depicts computer programs or systems that represent intelligence (Kim & Kim, 2022). AI has powerful capabilities to analyze data, identify patterns, and make decisions through using machine learning, natural language processing, and neural networks (Hong, 2023). Furthermore, AI mimics cognitive processes like learning, problem-solving, and decision-making in order to think and behave like humans (Deng & Lin, 2022; Kim & Kim, 2022). Its applications span across multiple fields, from education and healthcare to finance and autonomous systems, revolutionizing the way tasks are performed and enhancing efficiency in various sectors.

The emergence of AI has revolutionized language instruction (Gonulal, 2021; Liang et al., 2021; Waer, 2021) and challenged conventional teaching methods. For example, ChatGPT as the recent powered language model, has the potential to

improve all language skills (Fitria, 2023a; Hong, 2023; Kohnke et al., 2023). Therefore, AI's capabilities position it as a valuable ally for English teachers, supporting them in creating instructional materials and designing assessment tasks (Koraishi, 2023). Furthermore, a study with PSTs revealed a generally positive attitude towards incorporating AI tools into their classrooms (Kusuma et al., 2024).

Generative Artificial Intelligence has the potential to improve PST's knowledge of teaching using technology, particularly TPACK (Celik, 2023). GenAI can facilitate intellectual communication through interactive textual dialogues because of AI systems, such as natural language processing, machine learning, and deep learning (Kalla & Smith, 2023; Kohnke et al., 2023). GenAI can perform a variety of tasks, such as serving as a digital dictionary for English-language content (Kohnke et al., 2023), tutoring for writing skills (Huang et al., 2023), and translation (Baskara & Mukarto, 2023; Tsai, 2022). It also helps pedagogical activities, such as designing lesson plans and assessments (Kusuma et al., 2024), evaluating written text (Huang et al., 2023), and giving feedback (Rad et al., 2023). Moreover, AI is used as a medium to support teaching language skills, such as speaking (Tai & Chen, 2022), listening (Fitria, 2023b), reading (Daweli & Mahyoub, 2024), and writing (Alkamel & Alwagieh, 2024).

Unfortunately, only a few studies have explored the extent to which EFL PSTs integrate GenAI into their English language teaching (ELT) practices. Alrishan (2023) conducted research and found that EFL PSTs employed AI for their professional development. However, it was not clear enough for what purposes AI was specifically implemented during the professional development. Providing more specific purposes, Kusuma et al. (2024) explored the experiences of eight EFL PSTs who employed ChatGPT and found that these EFL PSTs used ChatGPT mainly for four purposes, such as collaborative instructional strategies, as innovative teaching content creation and presentation, language proficiency improvement, and development of effective assessments. They were done to improve their teaching techniques during the teaching practicums. Similarly, Wulandari and Purnamaningwulan (2024) conducted a research and recruited three EFL PSTs who employed AI during the teaching practicums. They found that these teachers employed AI for brainstorming and ideation process, teaching preparations, and generating teaching materials. Despite evidence suggesting that AI enhances teaching strategies and professional development, the specific mechanisms by which AI supports the development of TPACK among EFL PSTs remain underexplored, necessitating further research to clarify how AI tools facilitate the integration of technological, pedagogical, and content knowledge within TEPs. This investigation is critical for TEP development, as understanding AI's role in fostering TPACK can inform the design of targeted training that equips PSTs to effectively leverage technology in diverse educational contexts, ultimately enhancing teacher preparation and classroom outcomes.

Regarding academic integrity, it encompasses the principles of honesty, trust, fairness, respect, and responsibility in academic settings. It denotes academic honesty (Chaudhry et al., 2023), meaning that students, educators, and researchers are expected to uphold ethical standards in their work. This includes avoiding plagiarism, properly citing sources, conducting original research, and maintaining transparency in academic endeavors (Nketsiah et al., 2023). Analyzing academic integrity can be challenging since no one defines exactly what high from low

integrity is. Sometimes integrity tests depend on personal beliefs, thus it can be difficult to specify precise criteria (Holland & Ciachir, 2024).

Artificial Intelligence's potential to enable academic dishonesty, such as producing academic work with tools like ChatGPT, automated essay generators, or paraphrasing software without genuine effort or original thought, poses significant challenges for EFL PSTs in TEPs (Farrokhnia et al., 2023; Nikolic et al., 2024). For instance, PSTs might misuse GenAI to generate lesson plans, essays, or solutions to pedagogical challenges without engaging in the reflective learning process critical for developing TPACK, potentially hindering their ability to integrate technological, pedagogical, and content knowledge effectively (Chaudhry et al., 2023). This trend risks undermining TPACK development by bypassing the cognitive and creative processes needed to align technology with teaching goals, which could lead to superficial pedagogical practices. To maintain academic integrity and support TPACK growth, PSTs must use AI responsibly by acknowledging AI-generated contributions, verifying references to avoid fake citations, and critically evaluating AI-produced content for accuracy and bias (Cotton et al., 2023; Farrokhnia et al., 2023). Such practices ensure that GenAI serves as a tool to enhance, rather than replace, the development of robust teaching competencies in TEPs. While some research has explored specific uses of GenAI, such as content generation and assessment design, a holistic or theoretical exploration of how AI contributes to the interplay of technological, pedagogical, and content knowledge within a broader educational context remains underexplored. To address this gap and gain a deeper understanding of this complex phenomenon from the teachers' perspective, a qualitative exploration is necessary.

Method

Design, setting, and context

We employed a basic qualitative approach as the research design to explore the participants' perceptions. Particularly, we explored how EFL PSTs use GenAI for developing their TPACK and viewed academic integrity. We employed this approach due to its adaptability, which enables us to delve deeply into the subject without being constrained by a particular qualitative tradition (Merriam & Tisdell, 2016). For these purposes we contacted the Department of English Language Education at a public education university in Indonesia. This department comprised EFL PSTs well-suited for investigating AI's role in teacher education, as it systematically integrated the TPACK framework across its four-year TEP. Specifically, the program embeds TPACK through coursework and practicums that require PSTs to design technology-enhanced lesson plans, aligning digital tools like AI-based platforms with pedagogical strategies and content knowledge, fostering skills in selecting and ethically applying technologies to enhance language instruction. For example, PSTs engage in iterative cycles of planning, teaching, and reflecting in a course namely *Instructional Design and Technology* Course, where they critically evaluate AI tools for creating instructional materials, ensuring alignment with learning objectives while addressing ethical considerations such as transparency in AI use and mitigation of biases. This enabled PSTs to effectively teach subject matter using digital tools (Koehler & Mishra, 2005, 2009; Mishra & Koehler, 2006). In this regard, the study sought to learn more about the participants'

approaches to TPACK development with AI as well as their ethical concerns regarding academic integrity in the era of intelligent technologies.

Participants and researchers

The Institutional Review Board granted us ethical clearance (031/UN.48.16.04/PT/2025) to recruit participants prior to conducting the research. Two fourth-year classes with about 20 students each were made available to us. To set up an initial meeting with possible participants, we got in touch with the class coordinators. We clearly explained the study's goals, methods, and possible risks and benefits of participation during this meeting. We used a purposive sampling technique with the following criteria: (1) participants had used GenAI for more than six months to support their TPACK development, (2) possessed foundational knowledge of academic integrity, and (3) were willing and able to share their experiences. From an initial pool of twelve students identified as intensive AI users, eight were selected who fully met the criteria (Table 1). All participants, averaging 21 years old, had been using GenAI, particularly ChatGPT, for approximately 11 months, starting their exploration before their teaching practicum and intensifying usage during the practicum to support instructional planning and classroom implementation.

ChatGPT was chosen for this study as it was the generative AI tool most encouraged by the instructors at the time. They reported employing GenAI for several activities, such as content generators and lesson planning assistants, to create teaching materials and enhance classroom activities, while adhering to academic integrity by acknowledging AI contributions in their work, verifying AI-generated content for accuracy, and ensuring that their use of GenAI aligned with pedagogical goals without substituting original thought or effort, as guided by their teacher education program's emphasis on ethical technology integration. All ethical protocols were rigorously followed throughout the study. Participants were made aware that their involvement was completely voluntary and that they could stop at any moment without facing any repercussions. Before any data was collected, each participant gave their written informed consent. Pseudonyms were employed to preserve confidentiality and safeguard participant identity, and all data were anonymized throughout the transcription, analysis, and reporting processes. The research team ensured that data storage complied with institutional data protection guidelines, and access was restricted to authorized researchers only.

Regarding researcher involvement, two team members were affiliated with the host institution, which facilitated seamless coordination with the department head and class coordinators during participant recruitment and data collection. Their familiarity with the institutional setting also allowed for better contextual understanding of the curriculum and teacher preparation practices. The remaining team members were affiliated with other universities, bringing an external perspective that enriched the study's analytical depth. Despite differences in institutional backgrounds, all researchers shared a strong academic foundation in computer-assisted language learning and teacher professional development, which contributed to a well-rounded interpretation of the data.

Table 1. Participants' demographic information

No	Pseudonyms	Age	Gender	Length of AI usage
1	Yudha	21 years old	Male	8 months
2	Hery	22 years old	Male	12 months
3	Dewi	21 years old	Female	10 months
4	Titik	22 years old	Female	14 months
5	Artini	22 years old	Female	10 months
6	Karina	21 years old	Female	12 months
7	Sonia	21 years old	Female	14 months
8	Rahayu	21 years old	Female	9 months

Methods of data collection and instruments

To explore the research questions, we collected data through semi-structured individual interviews and researchers' notes. Each participant was invited to attend two interview sessions, each lasting approximately 30 minutes. The first session focused on how participants used AI to support their TPACK development, while the second session explored their perceptions of academic integrity in the context of GenAI use, particularly ChatGPT. To ensure participant comfort and reduce anxiety, two researchers conducted the interviews in Indonesian. In order to record pertinent behaviors, nonverbal clues, and possible analytical insights, the researchers also took observational notes during the interviews. Data triangulation was supported by these notes.

Five demographic questions and eight semi-structured questions that matched the goals of the study were included in the interview protocol. The eight interview questions were divided into two main sections: five questions focused on the use of ChatGPT for TPACK development, while the remaining three questions explored academic integrity and ethical AI use. Two independent experts evaluated the protocol's content validity. Some minor changes were made, like removing irrelevant questions and making the wording clearer. Following completion, the timing of the interviews was determined by the availability of the participants.

Data analysis

We transcribed the interviews in Indonesian, and the transcripts were thoroughly reviewed before the analysis process began. To analyze the data, two researchers employed an inductive thematic analysis following the framework proposed by Braun and Clarke (2006). This thematic analysis we did in this study involved six steps, such as familiarization with the data, generating initial codes, identifying and reviewing themes, defining and naming the final themes, and producing the final report. During the familiarization stage, the researchers read and re-read the transcripts to ensure clarity and began noting potential codes. In the subsequent coding phase, an initial set of 10 codes was identified. We reviewed these codes through a member triangulation process, in which the coding results were shared with other members of the research team for validation. We began our analysis by collaboratively developing 10 initial codes that captured key concepts from the data. Through an iterative process of constant comparative analysis, we then clustered these codes into five overarching themes based on their conceptual relationships and alignment with our research questions. To validate our findings and ensure their theoretical relevance, we systematically cross-referenced these

emergent themes and sub-themes with existing literature, confirming that our findings were both data-driven and theoretically grounded. When minor coding discrepancies did arise, they were addressed through collaborative discussion to reach a consensus, ensuring the integrity of the data. Finally, the themes, sub-themes, and representative excerpts were translated into English for the purpose of reporting and academic dissemination. The translated excerpts were then collaboratively analyzed by all members of the research team, leveraging their expertise as English lecturers.

Findings and Discussion

Findings

To answer the research questions, the inductive thematic analysis conducted in this study yielded five themes and ten subthemes with eighty-three relevant excerpts to support them as summarized in Table 2.

Table 2. Themes and Subthemes

Research Questions	Themes	Subthemes
In what ways do EFL PSTs use GenAI for their Technological Pedagogical Content Knowledge development?	AI as a Learning Tool for Language Skill Development	Writing Skill Development
		Reading & Listening Skill Enhancement
	AI for Learning Activity, Content Creation, & Task Assistance	Developing Learning Activities
		Generating Teaching Materials
		Grammar and Paraphrasing Assistance
To what extent do EFL PSTs perceive the use of GenAI and academic integrity?	Having Perceptions of Academic Integrity in AI-Assisted Learning	Knowing the Importance of Academic Integrity for Future Teachers
	Knowing the Potential Risks of AI on Academic Integrity	Knowing the Risk of Over-Reliance on AI
		Avoiding the Temptation to Use AI-Generated Content Without Critical Thinking
	Strategies for Maintaining Academic Integrity When Using AI	Setting Boundaries for AI Use in Learning & Teaching
		Verifying AI-Generated Work Using Detection Tools

AI as a learning tool for language skill development

A total of seven EFL PSTs expressed how they used ChatGPT to develop their writing skills. The data shows the early stage of TPACK development where PSTs are becoming comfortable in employing AI for specific linguistic purposes. They utilized ChatGPT for various writing-related tasks, including generating

ideas, structuring their writing, checking grammar, and refining vocabulary. Yudha shared that they primarily used ChatGPT to improve their writing by asking it to provide ideas and organization for their assignments:

> *I ask ChatGPT to look for ideas in my writing, for example, if there is an assignment about writing a paper or essay. Usually, I tell GPT to create a rundown of the points or flow of my writing. Then I develop my writing from these points, then ask ChatGPT to review my writing, starting from grammar to vocabulary selection. So from there, I can learn what things are missing in my writing*. (Yudha/Male/First Session Interviews).

Similarly, Hery used ChatGPT to check grammar and sentence structure. Hery would input the sentences and asked ChatGPT for feedback on the accuracy. Hery said, "If I use ChatGPT, then there are two possibilities. I have a sentence or paragraph that I'm not sure is correct or not, so I ask, 'Is this phrase or paragraph grammatically correct for academic purposes?" Moreover, Sonia used ChatGPT to support the writing skill development by referring to well-structured paragraph examples as Sonia said, "I often use it to get examples of good and correct paragraphs in English."

A total of four EFL PSTs described how they used ChatGPT to enhance their reading and listening skills, strengthening the development of content knowledge as a foundation to develop TPACK using AI. They utilized ChatGPT to generate reading materials, provide text-based content, and integrate with other AI tools for pronunciation and listening practice. Dewi and Titik used ChatGPT to find reading materials relevant to their coursework. For example, Dewi stated, "I use ChatGPT to find reading sources that are relevant to the material I am working on." Moreover, Yudha explained that ChatGPT helped him improve their reading skills by generating stories or scripts, which he then read aloud. However, Yudha paired ChatGPT with other AI technologies to assess his pronunciation, despite the fact that not all participants stated it except Yudha as he said, "For reading skills, we can tell ChatGPT to provide a story or script, then we read it ourselves, but we also need to integrate with other AI to check our pronunciation when reading stories from ChatGPT." In addition, Yudha used ChatGPT to support the listening skills by generating text and integrating it with AI-powered text-to-speech applications as Yudha said, "For listening skills, I tell GPT to provide text or vocabulary, then integrate it with AI which can apply sounds from a text. So I can practice from these activities." What Yudha did represents a higher level of TPK and an advanced understanding of how technology can extend pedagogy beyond traditional text-based activities, strengthening his TPACK development.

AI for learning activity, content creation, and task assistance

Seven EFL PSTs described how they used ChatGPT to develop learning activities for their future classrooms, showing how PSTs apply AI-generated suggestions to align with pedagogical goals as a creative way to develop their TPACK using AI. They utilized ChatGPT to design lesson plans, find suitable teaching materials, and create engaging activities such as games, icebreakers, and structured exercises. Dewi used ChatGPT to generate engaging classroom activities

and organize them in a progressive sequence as Dewi described, "As a prospective teacher, I have my own teaching style. Usually, I use games and icebreakers from search results on ChatGPT. Additionally, I told ChatGPT to create a learning flow from easy to more complex activities." Another participant, Artini, sought ChatGPT's help in designing creative lesson materials, particularly incorporating multimedia resources. Another example, Karina used ChatGPT to design writing activities, prompting students to write about familiar signs and develop short essays. Karina described, "[as suggested by ChatGPT] I asked the students to write whatever signs they knew. And after they know what the signs they know are, I ask them to make a small essay, a short story about the sign."

A total of five EFL PSTs described how they used ChatGPT to generate teaching materials and assist with content creation, demonstrating autonomy in sourcing linguistic input through AI. This suggests a redefined role of technology as a co-constructor of knowledge which is another base of TPACK development. They relied on ChatGPT to create reading texts, adjust vocabulary complexity based on student proficiency, and simplify difficult English texts. Yudha, for example, used ChatGPT to generate a Recount Text tailored to specific student levels as Yudha explained, "...We can adjust the target students, for example, the target is elementary school, then we can make the story shorter and choose to use vocabulary that is not too complicated for them." Another example, Hery used ChatGPT to generate reading materials specifically designed for sixth-grade elementary students. Hery stated, "I once used ChatGPT to create reading material suitable for 6th grade elementary school children." Additionally, Dewi highlighted the file upload feature in ChatGPT, which helped simplify complex English texts as Dewi said, "ChatGPT has a file upload feature. Sometimes there are English texts that are difficult to understand. This feature can be used so that we understand and change it into simpler words."

Four EFL PSTs described how they used ChatGPT for grammar and paraphrasing assistance in developing their teaching materials. Titik used ChatGPT not only for grammar checking but also for translation when preparing teaching materials as Titik described, "[ChatGPT] for translating and correcting grammar [for my teaching materials]." Additionally, Artini described the process of verifying the explanations with ChatGPT before refining the teaching content. Artini explained, "That's it, tell ChatGPT whether it's correct, whether there's anything wrong or whether it needs to be developed further. After that, I used ChatGPT to check grammar [for my teaching materials]." Karina emphasized the comprehensive role of ChatGPT in refining the instructional materials. Karina shared, "I use ChatGPT to paraphrase, translate, and improve my English grammar in my teaching material."

Perceptions of academic integrity in AI-assisted learning

All eight participants consistently expressed their views on the significance of academic integrity in AI-assisted learning, particularly for future educators. They all emphasized the importance of honesty, responsibility, and ethics in maintaining academic integrity while integrating GenAI into learning and teaching processes. Karina described integrity as a fundamental principle for teachers, stressing the importance of fairness and responsibility in carrying out their duties. Karina stated about her knowledge of academic integrity of using AI, "Perhaps the meaning of

integrity as a teacher candidate is carrying out your duties as a teacher honestly, fairly, and fulfilling your responsibilities as a teacher in the learning process." Rahayu highlighted the necessity of proper source acknowledgment, emphasizing that integrity is not just about avoiding plagiarism but also about understanding and verifying the credibility of information. Rahayu noted, "In my opinion, integrity is very important because we cannot just acknowledge the source as our reference. So, we have to know where the given source comes from."

Knowing the potential risks of AI on academic integrity

Six EFL PSTs in all voiced concerns about the possible drawbacks of an excessive reliance on GenAI in educational settings. They highlighted how excessive use of ChatGPT could lead to reduced engagement in reading, critical thinking, and independent idea generation. Hery admitted that using ChatGPT for summarizing academic journals made Hery felt more reluctant in reading and stated, "The negative impact is that I will become less diligent in reading because I can ask ChatGPT to summarize academic journals." Artini reinforced this concern, emphasizing how GenAI could lead to academic laziness and addiction. Artini remarked, "Maybe ChatGPT has a negative impact on these people, they become less diligent in reading. And I was like, reading journals doesn't spark my interest."

Seven participants highlighted concerns about the risks of relying on AI-generated content without critical evaluation. They acknowledged that while ChatGPT provides useful ideas, blindly using its outputs without modification can negatively impact learning and academic integrity. Yudha admitted that ChatGPT's high-quality writing tempted Yudha to use it without paraphrasing, leading to a challenge in developing Yudha own writing skills. Yudha shared:

> *Of course, I found negative impacts while I was using ChatGPT in practicing my writing skills. When I used ChatGPT, the resulting writing ideas from AI were so good that it gave me the feeling of using the writing without paraphrasing. This is a challenge in itself, because the capabilities that ChatGPT has can indirectly make us lazy to develop writing ideas from ChatGPT*. (Yudha/Male/Second Session Interviews)

Dewi emphasized the importance of modifying AI-generated ideas to suit students' needs, rather than adopting them as they are. Dewi explained, "I don't use ideas from ChatGPT fully because sometimes the results don't match my expectations. The basic ideas they produce are good, but the stages they provide are not suitable for our students."

Strategies for maintaining academic integrity when using AI

A total of seven participants discussed the importance of setting boundaries for AI use in education. While most agreed that ChatGPT can be a helpful tool, they emphasized the need for limitations to ensure students engage in critical thinking rather than relying entirely on AI-generated content. Titik highlighted the use of ChatGPT as a learning aid, particularly when students struggle to understand a topic. Titik explained, "Maybe when doing homework, if they (students) don't understand or what I'm talking about isn't within their understanding, maybe they

can use ChatGPT to ask for help to explain the topic as simply as possible." Rahayu stressed the importance of restricting GenAI use to early stages of learning, such as brainstorming and outlining, rather than allowing it for final content creation. Rahayu stated, "I will allow my students to use ChatGPT in the brainstorming and outlining stages, but not in the final text creation stage."

Six EFL PSTs emphasized the importance of using AI detection tools to monitor students' work and ensure academic integrity. They acknowledged that while AI can be beneficial, it is crucial to monitor and verify how students rely on AI-generated content. Dewi highlighted the necessity of AI detection tools like Zero GPT to maintain fairness in academic evaluation. Dewi stated, "I can't possibly discourage my students from using technology today. However, they have to know what their academic integrity is like and of course I also have to be equipped with an AI detector like Zero GPT." Similarly, Artini stressed the importance of identifying AI-generated work and taking appropriate action, explaining, "I will check their assignments using Zero GPT. So, I know which ones are made by AI, if they are really 100% made by AI, I will reprimand them."

Discussion

Answering the first research question, the findings revealed that EFL PSTs employed AI in diverse and meaningful ways to develop their TPACK. They used GenAI for language skill development, content creation, and teaching preparation. This supports the idea that they are capable of leveraging digital tools although PSTs are still developing pedagogical skills (Kusuma et al., 2024). Perhaps, it was due to their digital nativeness and exposure to TPACK frameworks during TEPs (Habibi et al., 2020; Park & Son, 2020). Moreover, the participants used AI for writing skill development, such as generating ideas, improving sentence structure, and refining grammar. These findings aligned with Huang et al. (2023), who noted AI's potential in tutoring writing. Additionally, the AI was used for reading and listening by generating reading materials and exploring texts to improve comprehension. These extended findings from Daweli and Mahyoub (2024) as well as Fitria (2023b) into the PSTs context. The use of AI for lesson preparation, such as brainstorming and generating teaching activities, mirrored the findings found by Kusuma et al. (2024) and Wulandari and Purnamaningwulan (2024). However, this study offers a more nuanced breakdown into specific TPACK components, showing how PSTs balance technological, pedagogical, and content knowledge in their practices.

Furthermore, the results revealed that EFL PSTs applied GenAI not only for task automation, that is, (e.g., grammar checking or material generation), but also for cognitive support, particularly by means of reflective dialogue targeted at improving their teaching strategies. Participants also used AI for pedagogical ideas, discussed student-centered learning, and explored teaching methods. These activities, while seemingly focused on content creation, indicate a deeper level of intellectual engagement. For example, Dewi's use of ChatGPT to create a "progressive sequence" of activities demonstrates a pedagogical inquiry into the principles of scaffolding and learning flow. Similarly, Karina's use of ChatGPT to design a writing task that moves from familiar signs to a short essay reflects a reflective dialogue with the tool about how to build a coherent and engaging learning progression. This suggests that GenAI is functioning not merely as a digital

assistant but as a thinking partner in the learning-to-teach process, helping PSTs to critically reflect on and form their own pedagogical approaches. While previous studies have highlighted how PSTs use GenAI for planning, assessment design, and content creation (e.g., Kusuma et al., 2024; Wulandari & Purnamaningwulan, 2024), few have documented this interactive, dialogic use of AI to enhance pedagogical reflection. This finding contributes to the broader TPACK discourse by illustrating how Technological Pedagogical Knowledge is being developed in dynamic and iterative ways through AI-facilitated metacognition. From a theoretical perspective, this aligns with Koehler and Mishra's (2005, 2009) view that TPACK is context-dependent and requires constant negotiation between knowledge domains. The reflective use of ChatGPT shows how PSTs are engaging in this negotiation in real time, using AI to scaffold their pedagogical reasoning and content delivery decisions.

Moreover, this extends the function of natural language processing-based AI tools, which prior literature primarily recognized as content generators or feedback providers (e.g., Kohnke et al., 2023; Huang et al., 2023). In contrast, the present study adds a new dimension to AI's educational role, such as facilitating pedagogical inquiry and teacher identity formation. This insight not only enriches the current understanding of how PSTs are interacting with AI but also opens new directions for AI-integrated teacher education programs, where AI is not merely a tool for outputs, but a co-agent in the thinking and learning process.

Answering the second research question, EFL PSTs in this study demonstrated strong awareness of academic integrity, echoing global standards of ethical academic behavior (Chaudhry et al., 2023; Nketsiah et al., 2023). The findings indicated that they emphasized the importance of honesty and transparency. It is because they are future educators and are expected to be role models. This mirrors Holland and Ciachir (2024), who noted the difficulty of assessing integrity due to subjective interpretations. Participants acknowledged the risks of AI misuse, including over-reliance and passive learning. As also suggested by Farrokhnia et al. (2023), GenAI tools like ChatGPT can lead to academic dishonesty if not guided by ethical awareness. However, unlike other studies, these participants not only expressed concerns, but also proposed self-initiated strategies such as cross-checking sources, limiting AI use to idea generation, and using AI-detection tools to verify authenticity.

Moreover, the findings also indicated that EFL PSTs were already forming personal boundaries around AI use and demonstrating an internalized sense of academic integrity, even in the absence of strict institutional enforcement. Perhaps, this internal accountability is a manifestation of evolving digital ethics among digital natives (Park & Son, 2020). The emergence of such ethical self-regulation may be attributed to the ethical and pedagogical foundations developed through TEPs. As noted by Kusuma (2022a) and Yüksel & Kavanoz (2011), TEPs increasingly embed the TPACK framework, which not only equips PSTs with technological, pedagogical, and content knowledge but also fosters critical awareness about when and how to use technology appropriately in educational settings. Furthermore, academic integrity, as highlighted by Chaudhry et al. (2023) and Nketsiah et al. (2023), is grounded in values such as honesty, trust, and responsibility, principles that PSTs in this study actively upheld by verifying AI-generated content, avoiding over-reliance, and critically evaluating outputs. This

behavior aligns with broader findings that digital competence now includes ethical AI use, not just technical skill (Farrokhnia et al., 2023; Cotton et al., 2023).

Thus, the participants' cautious and reflective use of GenAI, combined with their awareness of potential academic risks, suggests that ethical use of technology is becoming internalized as part of their professional identity. This represents a new dimension of TPACK development, one that integrates not only what teachers know and do, but how they choose to act when navigating complex digital environments. This finding opens new possibilities for reimagining teacher education, where AI literacy and ethical reasoning are embedded not only as skills but as dispositions essential for 21st-century educators.

This study makes theoretical and practical recommendations for TEPs based on the results and the above discussion. Theoretically, it highlights the necessity of broadening the TPACK framework by acknowledging GenAI as a dialogic partner that facilitates reflective practice and pedagogical reasoning in addition to being a technological tool. This implies that models of teacher knowledge should more explicitly incorporate AI-facilitated metacognition, in which EFL PSTs converse intellectually with AI to improve their strategies. Practically, TEPs should embed structured opportunities for EFL PSTs to explore AI tools, such as ChatGPT, within a TPACK-focused curriculum that emphasizes ethical and reflective use. This involves designing activities that guide PSTs to critically evaluate AI outputs for accuracy and bias, align AI use with pedagogical objectives, and foster metacognitive dialogue to enhance Technological Pedagogical Knowledge and Pedagogical Content Knowledge. Additionally, TEPs should provide explicit training on digital ethics and academic integrity, equipping PSTs with strategies to navigate AI's potential risks (e.g., over-reliance, academic dishonesty). Such training would reinforce TPACK development by fostering dispositions for responsible technology integration, preparing PSTs to be technologically skilled, pedagogically reflective, and ethically grounded educators.

Conclusion

To conclude, the findings of this study demonstrate that through their engagement with AI tools such as ChatGPT, EFL PSTs actively develop key components of the TPACK framework. Specifically, EFL PSTs developed their technological, technological content, and technological pedagogical knowledge as foundations of TPACK. Furthermore, EFL PSTs developed a strong awareness of academic integrity. Often without institutional control, participants actively set personal limits, showed ethical judgement, and used artificial intelligence responsibly.

This study is far from perfect as it has several limitations. It recruited small samples of participants from a single institutional context only. Although this approach yielded insightful results, more participants will bring more insights. To build on this work, future research should explore similar inquiries using mixed-methods or longitudinal designs, which could capture the evolving nature of GenAI use in teacher development over time. Comparative studies across different institutions or cultural contexts would also be valuable to identify how contextual factors influence TPACK development and ethical behavior in AI integration. Moreover, the study is limited to the use of ChatGPT and does not explore PSTs' interactions with other generative AI tools and the study's findings are based on

self-reported perceptions of academic integrity, which may not fully align with actual practices. Future studies are expected to explore more GenAI tools and how the EFL teachers use them practically.

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Appendix

Section 1: Use of ChatGPT for TPACK Development

1. What kind of activities do you usually do using ChatGPT to advance your professionalism as an EFL preservice teacher?
2. How do you perceive the role of ChatGPT in your own TPACK development?
3. In your experience, how has ChatGPT helped you understand or improve your use of technology in teaching English (technological knowledge)?
4. How do you perceive ChatGPT's role in developing your understanding of effective teaching methods (pedagogical knowledge)?
5. How has ChatGPT influenced your content knowledge, especially regarding English language teaching topics?

Section 2: Academic Integrity and Ethical AI Use

6. To what extent do you feel that using ChatGPT to generate ideas for classroom management, teaching activities, or assessment design is acceptable within the framework of academic integrity?
7. What do you believe are the ethical boundaries when using ChatGPT for your TPACK development?
8. In which ways do you think the use of ChatGPT can align with maintaining academic integrity in your TPACK development, and where do you see potential for misuse?