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M-AI – the force – be with you: Pre-Service Teachers' Preparedness for Distance English Teaching

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Abstract
This study addresses whether Generation Z pre-service teachers of English as a Foreign Language are prepared to deliver artificial intelligence-supported online instruction. The main aim is to evaluate this preparedness through the lens of the Technological, Pedagogical, and Content Knowledge framework. The significance of the study lies in identifying areas of competence that English language teacher education programmes should prioritise to better prepare future teachers for artificial intelligence-supported online language teaching. Drawing on a mixed-methods case study, the research analyses 22 Slovak master's students enrolled in a distance-teaching methodology course, in which they were required to use at least one artificial intelligence-driven tool. Data were corroborated from lesson observations and video recordings and analysed using qualitative content analysis aligned with the three domains: technological, pedagogical, and content knowledge. The findings indicate that most participants demonstrated moderate preparedness, while only a minority achieved high-level integrated competence, and a similar proportion showed low preparedness. Although students were generally able to operate artificial intelligence tools, pedagogical integration and language-focused instructional design were often weak. In particular, scaffolding, feedback, and explicit language-learning objectives were frequently underdeveloped. The results suggest that digital nativeness does not guarantee the pedagogically meaningful use of artificial intelligence and highlight the need to integrate artificial intelligence pedagogy, grounded in the Technological, Pedagogical, and Content Knowledge framework, into English as a Foreign Language teacher education.

Keywords: Artificial Intelligence, distance education, EFL teacher education, online instruction, TPACK framework, AI-supported distance English teaching

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Introduction

AI-driven technologies offer significant opportunities to enhance students' learning experiences. Recent studies highlight the potential of artificial intelligence (AI) to support online teaching practices (Guerrero-Roldán, 2021; Ng et al., 2021; Seo et al., 2021). Despite these opportunities, many educators lack the technological expertise and experience required to use AI-driven tools effectively. Teacher competence is, therefore, a crucial prerequisite for successful AI integration into online education. Teachers are expected not only to upgrade their technical skills but also to connect AI tools with content knowledge and pedagogy. Researchers emphasise the need for targeted support to develop teachers' practical application skills and stress that teacher preparation programmes must equip future teachers with the technological, pedagogical, and ethical competencies required for effective AI integration (Moorhouse & Kohnke, 2024; Pondelíková, 2025).

Although today's Gen Z pre-service English as a Foreign Language (EFL) teachers demonstrate high levels of familiarity with digital technologies thanks to early immersion (Pondelíková, 2025), this proficiency does not automatically translate into pedagogical competence or the ability to deliver effective online lessons. As artificial intelligence (AI) becomes increasingly integrated into language education, a key research problem emerges: little is known about how prepared Slovak pre-service EFL teachers are to use AI tools pedagogically in online teaching environments. Systematic reviews of AI integration in language teaching contexts confirm that pre-service teachers remain largely underrepresented in this body of research compared to in-service educators (Zaidi et al., 2026). In particular, their preparedness within the Technological, Pedagogical, and Content Knowledge (TPACK) framework has not yet been fully examined.

To address this gap, the present study draws on the TPACK model to investigate Slovak pre-service teachers' preparedness for AI-supported online teaching through lesson observations and content analysis of video-recorded micro-teaching sessions delivered by master's students majoring in Teaching English Language and Literature. The significance of the study lies in its potential to inform English teacher education programmes about competence gaps that require targeted attention.

The study pursued two research objectives: (1) to evaluate the levels of technological, pedagogical, and content preparedness demonstrated by Slovak pre-service EFL teachers during AI-supported micro-teaching, based on observation and video analysis ratings, and (2) to examine the relationships among the three TPACK domains reflected in these ratings.

Specifically, reflecting the TPACK framework, the study sought to address the following research questions:

1. What level of technological preparedness (low, moderate, or high) did pre-service EFL teachers demonstrate while delivering AI-supported online micro-teaching activities?
2. What level of pedagogical preparedness (low, moderate, or high) did pre-service EFL teachers present during AI-enhanced online micro-teaching?
3. What level of content-related preparedness (low, moderate, or high) did pre-service EFL teachers showcase in AI-supported online teaching activities?
4. Were the three TPACK domains (technological, pedagogical, and content knowledge) mutually related based on the ratings assigned by the researchers?

The first three questions are addressed through qualitative content analysis, while the fourth employs quantitative correlation analysis to examine ordinal associations among the three domain

ratings. Including both approaches reflects the study's mixed-methods design, in which the quantitative strand adds precision to the qualitative findings by revealing whether stronger preparedness in one TPACK domain co-occurs with stronger preparedness in the others.

Literature Review

This literature review examines teachers' roles and challenges in distance education, as well as pedagogical models that guide effective technology integration. It outlines the principles of the TPACK and SAMR frameworks and highlights AI literacy and competence as key prerequisites for successful AI-supported online instruction. Addressing these aspects is essential because they provide the conceptual and analytical foundation for investigating the key research gap identified in this study, namely, the limited understanding of Slovak pre-service teachers' preparedness for AI-supported online teaching. These elements are closely interconnected, as they collectively inform how future teachers can be effectively prepared for AI-enhanced online educational environments, particularly by developing the pedagogical, technological, and content knowledge needed to integrate AI tools into teaching practice meaningfully.

Distance Education and Its Challenges

Zydziunaite et al. (2021) define teaching as the transmission of knowledge and skills to facilitate learning and comprehension. It involves an educator guiding students through lessons, exercises, and interactions. Distance teaching follows the same principles but uses technology, with participants in separate locations (Geçer et al., 2023). According to the Cambridge Dictionary (2025), distance learning occurs when students study from home and receive instruction and assignments online. When combined, these processes form distance education, encompassing both teaching and learning. This shift challenges educators to design engaging classes despite their students' physical absence.

Distance education occurs remotely and takes two main forms: synchronous and asynchronous learning. In asynchronous models, teachers provide materials for independent study, i.e., an ICT-based mode of self-directed learning (Turek, 2014). Synchronous education, by contrast, involves real-time interaction through live online meetings, enabling group, pair, or individual learning (Kohnke & Moorhouse, 2022). Although students learn from home, they participate in weekly sessions that resemble traditional courses, preparing through research and assignments. As Sewart, Keegan, and Holmberg (2020) note, institutions that administer asynchronous distance programs typically address three main tasks: creating self-instructional materials, providing feedback on students' work, and offering support via distance media such as email or video calls.

The chief advantage of synchronous online education is the teacher's real-time presence, which allows immediate clarification and feedback. However, this mode depends heavily on technology, which can hinder communication through poor Internet access, faulty devices, or limited technical skills (Çeşme & Çimen, 2023). During the COVID-19 pandemic, for example, teachers often struggled to manage breakout rooms, leading to frustration and reduced efficiency (Mahyoob, 2020).

Another recurring drawback of distance education is the lack of face-to-face interaction, making it harder for students to seek help or stay motivated. Without the social and institutional structures of in-person learning, students must rely more heavily on self-regulation, and poor time management and procrastination are closely linked to academic misconduct, undermining students' academic and professional development (Aruğaslan, 2024).

Preparing future teachers for the challenges of distance education

Pre-service teacher education is a crucial stage for developing professional identity and core pedagogical competencies (Matjašič & Vogrinc, 2025). Strengthening pre-service teachers' self-efficacy is vital, as it directly shapes the quality of their classroom management and the motivational support they can provide to learners (Metzner et al., 2025). At the same time, teacher education must increasingly foster digital competence to prepare future educators for globalised, technology-mediated learning environments, as pre-service teachers demonstrate adequate digital skills for everyday tasks but weaknesses in pedagogical integration. Teacher education programmes must address this gap by better aligning academic training with practical experience (Zhang et al., 2026; Dolezal et al., 2025).

The COVID-19 pandemic accelerated this transformation, forcing a sudden shift to online learning (Çebi & Reisoğlu, 2020). This transition revealed weaknesses in traditional preparation, especially regarding social interaction, teacher–student relationships, and digital feedback (Çebi & Reisoğlu, 2020; Boumadan et al., 2020). Many pre-service teachers felt unprepared for digital teaching despite regular use of technology. Yet, engagement in emergency remote teaching enhanced their self-efficacy and familiarity with collaborative digital tools (Jamil et al., 2025; Dolezal et al., 2025).

The crisis also advanced the integration of digital ethics and AI-related competencies, underscoring the need for educators who are technologically adept, pedagogically flexible, and resilient in hybrid contexts (Parz-Kovacic et al., 2026). Consequently, teacher education has begun shifting from basic technical literacy to broader digital ecoliteracy, promoting critical thinking and adaptability in complex digital settings (Tomczyk et al., 2023; Dolezal et al.,2025).

Despite being digital natives, many pre-service teachers still feel ill-prepared to foster digital competence in their pupils (Dolezal et al., 2025). Their confidence in basic digital tasks contrasts with lower self-efficacy in using innovative pedagogical tools, particularly among non-STEM students and those with teaching practice experience (Jamil et al., 2025). In response to these disparities, the European Framework for the Digital Competence of Educators (DigCompEdu) provides a comprehensive model outlining what it means to be a digitally competent educator (Redecker, 2022). Nevertheless, rather than focusing solely on technical proficiency, it emphasises how digital technologies can transform educational practice (Dolezal et al., 2025). Thus, preparing pre-service teachers for effective online instruction requires more than merely developing their digital skills.

Technology-Integrating Pedagogical Models as a Foundation for Effective Distance Education

As demonstrated by Mishra and Koehler's (2006) Technological Pedagogical and Content Knowledge (TPACK) model (see Figure 1), effective technology integration in teaching requires a complex interplay of technological, pedagogical, and content knowledge. This framework emphasises understanding how these domains interact to create specific areas of expertise, rather than perceiving them as separate forms of knowledge (Boumadan et al., 2020; Dolezal et al., 2025).

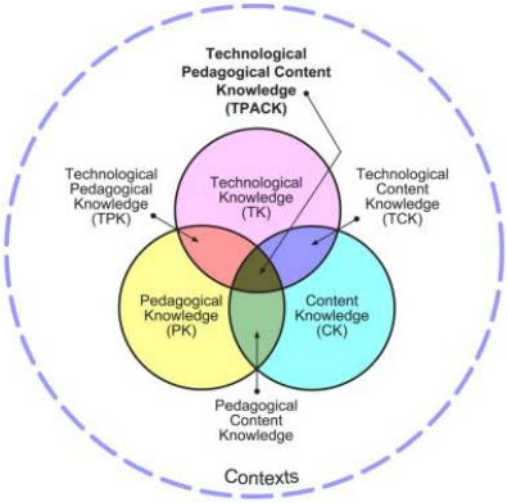


Figure 1. The TPACK Framework (Mishra, 2006)

Building on Shulman's (1986) concept of pedagogical content knowledge, TPACK identifies three intersecting components: content knowledge (CK), pedagogical knowledge (PK), and technological Knowledge (TK). According to Wang et al. (2018), PK encompasses teachers' understanding of teaching methods, learning objectives, and educational values. TK refers to teachers' ability to use and adapt to technological tools, while digital competence now extends beyond technical proficiency to include responsible, ethical, and secure technology use (Falloon, 2020). CK represents teachers' mastery of subject content; in EFL teaching, this includes linguistic accuracy, fluency, and control of pronunciation, which are essential for effective mediation and modelling of language performance. Together, these domains enable teachers to design meaningful learning experiences. In distance EFL education, for instance, TPACK guides the integration of AI tools to support specific language skills within student-centred environments.

However, TPACK is not static; it evolves with teachers' experience and available technologies (Harris et al., 2009). Complementing this model, Puentedura's (2013) SAMR framework, which stands for substitution, augmentation, modification, and redefinition, focuses on the depth of technological integration (see Figure 2).

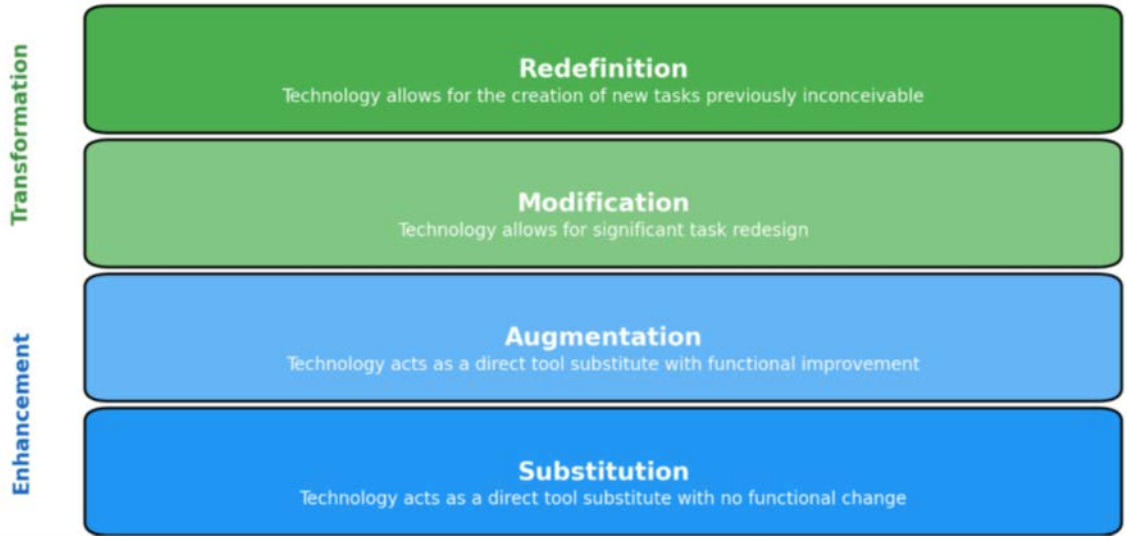


Figure 2. The SAMR Model of Technology Integration (adapted from Puentedura, 2013)

At lower levels, technology substitutes for or enhances traditional tools (e.g., writing in Microsoft Word with spell-check). At higher levels, it enables task redesign or the creation of entirely new learning experiences, such as international student collaborations on digital magazines or podcasts using tools like Padlet, Canva, or Zoom.

With the emergence of AI, the transformative stages of the SAMR model have become increasingly attainable, enabling "significant task redesign" and "previously inconceivable" learning opportunities. AI is thus reshaping the educational landscape, prompting re-evaluation of how teaching and learning must evolve in the twenty-first century.

AI Literacy and Competence in the Context of Teacher Education

Colleges and research institutions worldwide are examining the efficiency and potential of AI-driven applications in education. Some fear AI could replace educators or weaken the social and emotional dimensions of learning; others emphasise its transformative potential to personalise education, streamline administrative tasks, and expand access to information in economically disadvantaged areas (Holmes et al., 2019). They argue that AI may free educators to focus on creativity, communication, and emotional intelligence while offloading repetitive tasks. Ghamrawi et al. (2024) argue that AI should be viewed as a complementary tool that augments teachers' capabilities rather than threatening their authority or humanity, suggesting that, if implemented wisely, it can significantly improve learning outcomes and deliver personalised, adaptive learning experiences. This hybrid model, in which AI augments rather than replaces traditional methods, is often described as a "dual-teacher paradigm," where AI supports customisation and logistics. At the same time, instructors retain their central role in mentoring and facilitation, which remains one of the most equitable paths for the future of education (Holmes et al., 2019). Consequently, recent research underlines the growing importance of digital ethics and AI-related competencies in teacher education curricula (Osorio Vanegas et al., 2025).

Knowledge is closely tied to literacy, as both involve comprehension. Competence, however, goes a step further by emphasising the effective application of that knowledge in real-world contexts. It incorporates confidence, attitudes, and performance, reflecting how well an individual can accomplish specific tasks, such as using AI tools effectively. In this sense, literacy focuses on knowing, while competence emphasises doing, i.e., applying knowledge in meaningful and practical ways (Chiu et al., 2024; Pondelíková, 2025).

In today's world, AI competence has become a crucial technological skill. Long and Magerko (2020) explain that it equips individuals to critically evaluate AI technologies, engage with and collaborate effectively, and transfer their use across diverse personal and professional contexts. At the same time, Ng et al. (2021) argue that teachers must also cultivate AI literacy, i.e., understanding ethical concerns, recognising AI's limitations, and being aware of its human-centred design, to better guide students' learning.

Building on Long and Magerko's (2020) sixteen AI-related competencies, Bloom's revised taxonomy (Anderson & Krathwohl, 2001), and Touretzky et al.'s (2019) discussions of "the impact of AI on society," Ng et al. (2021) grouped AI competencies into four overarching categories: "know and understand," "use and apply," "evaluate and create," and "ethical issues." These categories are intended to guide the development of students' AI knowledge from lower-order to higher-order thinking, each requiring progressively more complex skills and assuming that mastery of one stage is required before advancing to the next (Pondelíková, 2025, p.17).

"Know and understand AI" corresponds to the foundational levels of Bloom's taxonomy, emphasising basic knowledge and comprehension. "Use and apply AI" reflects the application level, focusing on the practical use of AI concepts. "Evaluate and create AI" aligns with the higher levels, requiring analysis, evaluation, and creation (Pondelíková, 2025, p.17). The final category, ethical issues, highlights the importance of educators' awareness of the ethical dimensions of AI systems. Teachers should actively safeguard students' psychological and social well-being when integrating AI, recognising potential risks and ethical and safety challenges in teaching, learning, and assessment. They must also remind students of these concerns, including the environmental impact of AI, given its significant energy consumption (Rillig et al., 2023). Recent ethical guidelines, therefore, urge educators to prioritise the responsible and ethical use of AI and data in educational contexts (European Commission, 2022).

AI literacy and competence can be meaningfully aligned with established models of technology integration, such as TPACK and SAMR. Within TPACK, AI literacy corresponds to technological knowledge (TK), that is, a foundational understanding of AI concepts, functions, limitations, and ethical considerations. AI competence reflects the full TPACK intersection, encompassing not only knowledge of AI but also its confident, effective application to meet specific educational goals in authentic contexts. Thus, teachers move from simply knowing about AI to designing and implementing meaningful AI-enhanced learning experiences, while remaining aware of their broader societal and ethical implications.

A similar progression appears in the SAMR model (Puentedura, 2013). "Know and understand AI" aligns with Substitution and Augmentation, where AI supports basic knowledge acquisition and comprehension. "Use and apply AI" corresponds to Modification, as AI tools reshape how tasks are performed and allow students to apply knowledge in practical, innovative ways. "Evaluate and create AI" maps onto Redefinition, where students analyse, evaluate, and create with AI, engaging in tasks that were previously inconceivable without such technologies. This stage also incorporates ethical issues, reminding educators that AI integration should foster not only cognitive development but also students' social, emotional, and environmental well-being.

For the present study, we adopted the TPACK model to evaluate EFL pre-service teachers' preparedness to deliver AI-enhanced online lessons, focusing on their technological, pedagogical, and content knowledge. Technological preparedness was defined as the ability to competently use digital tools and AI technologies in online teaching, troubleshoot technical issues, and ensure accessibility and a smooth user experience. Pedagogical preparedness refers to designing and adapting activities that align with educational goals, sustain engagement, and use AI tools to enhance learning outcomes, for instance, creating student-centred lessons, using AI for personalised instruction, giving clear directions, managing time, assessing students, and reflecting on and improving future teaching. Content preparedness was understood as the teacher's ability to teach specific topics or aspects of English accurately and confidently, including appropriate language use and suitable didactic approaches.

Given its established role in developing and assessing pre-service teachers' TPACK, micro-teaching provides a particularly suitable context for examining this preparedness. Research shows that micro-teaching fosters key competencies such as lesson planning, feedback provision, classroom management, information and communication technology integration, and reflective practice, all of which make TPACK observable in practice (Iliasova et al., 2025). At the same time, studies on AI-enhanced micro-teaching highlight recurring challenges related to technical

troubleshooting, the meaningful integration of AI tools into pedagogical activities, and the considerable time required for planning AI-supported lessons (Alpysbayeva et al., 2025). These challenges point to potential weaknesses at the intersection of technological and pedagogical knowledge. Despite these findings, little is known about how pre-service EFL teachers navigate such challenges and demonstrate AI-related TPACK in online teaching contexts. This study addresses this gap by investigating the preparedness of Slovak pre-service EFL teachers to integrate AI tools into online micro-teaching lessons through the lens of the TPACK framework.

Methodology

Research Design

This study employed a mixed-method case study design to examine pre-service EFL teachers' preparedness for AI-supported online instruction at Constantine the Philosopher University in Nitra, Slovakia, using semi-structured observation as the primary method. The research took place in the 2024/25 academic year.

First, we observed future English teachers' micro-teaching activities and collected field notes (see Appendix A). Designing and delivering a micro-teaching activity was one of the assignments and a requirement for passing the Didactics of Distance English Teaching course, a weekly ninety-minute class taught over the thirteen-week winter semester in 2024. A key condition was the inclusion of at least one AI-driven tool in the micro-teaching activity. Micro-teaching, as a practical didactic tool, involves brief lessons delivered by pre-service teachers to peers acting as learners. By linking theory with practice, it simulates real-life teaching in a safe environment and supports the implementation of innovative pedagogical approaches.

After an introduction to the essentials of online English language teaching during the first three weeks, participants were instructed to explore various AI tools, including adaptive learning systems, chatbots, grammar checkers, and speech recognition tools, and to apply at least one in their teaching sessions. This requirement aimed to familiarise them with the potential of AI in language education and to provide hands-on experience with appropriate classroom use. To support autonomous learning, students were asked to discover AI tools independently and were free to choose which tool to integrate.

Since the sessions were recorded, observations were complemented by video analysis, allowing a more detailed examination of AI tool integration and pre-service EFL teachers' readiness for AI-enhanced online instruction. Data from these two sources were corroborated, and conclusions were drawn in relation to the research questions.

Participants

Convenience sampling was applied, as all 22 students enrolled in the master's study programme Teaching English Language and Literature attended the Didactics of Distance English Teaching course in the 2024/25 academic year. All participants were Slovak nationals, including 19 students in their fourth year and three students in their fifth and final year of the master's programme. The cohort consisted of 8 male and 14 female students, with an average age of approximately 22 to 24 years. Master's students were considered appropriate for this study as they possess prior academic experience from their bachelor's studies, practical teaching experience with primary and secondary school students, and are preparing to enter professional teaching environments in which the integration of artificial intelligence is increasingly expected.

Each week, three to four students delivered a 15-minute micro-teaching session. This time limit was chosen both to reflect the course constraints and to encourage participants to focus on key lesson elements, ensuring clarity and efficiency. In each session, the presenting student acted as the teacher, while classmates took on the role of learners, creating an active, dynamic classroom environment.

Regarding the observers, one researcher functioned as a "participant-as-observer" – the course instructor, who was a member of the group and observed what occurred. The second researcher served as an "observer-as-participant," attending every lesson and being known to the group but not part of it, thus able to record events with some detachment (Cohen et al., 2017).

Data Collection

Field notes and video recordings were used in combination to strengthen the validity of the findings.

Field notes

Observations during the micro-teaching activities were guided by predefined criteria and documented in the researchers' field notes using an observation sheet (see Appendix A). The observers focused on aspects identified in advance while retaining the option to add emergent details. The criteria reflected the three key TPACK domains, i.e., ***technological***, (including *Type of AI tools and alignment with teaching objectives, Level of effective AI integration, Overall technological efficiency, Technical issues and troubleshooting*); ***pedagogical*** (comprising *Student/teacher centredness, Clarity of instructions, Clarity of explanations, Time management, Student engagement, Interaction and support, Monitoring and feedback*); and ***content*** knowledge (including *Content delivery, Accurate and fluent language use*). Each criterion is mapped to the three preparedness levels (low, moderate, high) through a detailed evaluation rubric (see Appendix C).

Video recordings

As the online micro-teaching sessions were video-recorded by the observer-as-participant using Open Broadcast Software (OBS), who remained silent throughout each session, the field notes, i.e., the data from the observation, were supplemented with data from video-recording analyses, focusing on the same TPACK-based criteria as the observation sheet. Notes and ratings were recorded during repeated viewing of the sessions. Participants were informed about the recording process and provided written consent before the sessions. Access to the recordings was restricted to the two researchers, the course instructor and the observer, ensuring confidentiality throughout the analysis process.

Data Analysis

Data were analysed using qualitative content analysis. The material from observations and video recordings was examined with reference to the three core TPACK components: technological, pedagogical, and content knowledge. Data collected by the two observers were processed through ongoing consultation and comparison of their partial results.

Categories and Coding

Manual inductive coding was applied to the data sets. Two authors were selected as primary coders to analyse the open-ended responses from field notes and video recordings. Before coding, both coders underwent comprehensive training focused on the thematic elements identified in the

TPACK model and a content analysis framework (Schmid et al., 2021). They independently coded the data in vivo, summarising participants' words into an initial list of codes. The codes were then grouped into the three TPACK categories: technological, pedagogical, and content knowledge. ***Technological knowledge*** included the following codes: *the level of effective integration, overall technological proficiency*, and *constraints related to AI tools or videoconferencing*, including limitations on instructional flexibility and peers' challenges with the technologies. ***Pedagogical knowledge*** comprised *lesson design and pedagogy* (i.e., adaptation of lessons for distance learning, pedagogical strategies used by presenters, the degree of student-centredness and AI support for it, clarity of instructions and explanations, time management) and *student engagement and interaction* (i.e., whether the activity aroused interest and active participation, the nature and effectiveness of presenter-peer interactions, and feedback mechanisms). ***Content knowledge*** focused on *effective content delivery* while integrating AI tools (i.e., meaningful, appropriate and accurate presentation of the selected topic, grammar issues, or vocabulary). In the context of English as a Foreign Language (EFL) teaching, it also included *accurate and fluent language use*, including good command of grammar and vocabulary, and correct pronunciation throughout instruction. Subsequently, data from observations and video recordings were summarised into categories that aligned with the research questions. Preparedness was then operationalised across three levels, clearly defined within each category.

Technological Preparedness

Low technological preparedness was indicated by cases in which links to websites were not shared properly, instructions for using AI were vague or missing, or the presenter was unable to troubleshoot. *Moderate technological preparedness* was evident in cases where AI tools worked but were not integrated smoothly, instructions were somewhat clear but required clarification, and technical issues occurred but did not hinder the lesson. *High technological preparedness* was defined as seamless operation of multiple digital tools, clear instructions, and effective troubleshooting or backup strategies.

Pedagogical Preparedness

Low pedagogical preparedness was observed when AI tools were used without a clear pedagogical purpose, alignment with learning objectives, or follow-up activities. Instruction lacked scaffolding, feedback, learner monitoring, and formative assessment, and activities were predominantly teacher-centred with vague instructions or abrupt transitions. *Moderate pedagogical preparedness* was evident in sessions where AI tools were meaningfully selected, and instructions were generally clear, but pedagogical integration remained partial. Although the activities were engaging, scaffolding, feedback, reflection, and explicit links to language outcomes were limited, resulting in underdeveloped learning outcomes. *High pedagogical preparedness* was evident in lessons where AI use was fully aligned with clearly defined learning objectives and embedded in a coherent instructional design, with effective scaffolding, learner-centred activity design, formative assessment, reflective practice, and purposeful AI use to support engagement and language development.

Content Preparedness

Low content preparedness was characterised by sessions in which presenters demonstrated limited clarity of content focus, weak or absent links between language goals and learning

activities, and inaccurate, hesitant, or poorly controlled language use (including grammar, vocabulary, and pronunciation). Instruction lacked clear goal setting and reflection, with minimal language-focused learning and insufficient attention to language systems and skills. *Moderate content preparedness*: described sessions with adequate subject knowledge and generally accurate and fluent language use, but with weak or inconsistently reinforced connections between activities and intended language-learning outcomes. Although topic knowledge and basic control of grammar, vocabulary, and pronunciation were evident, instructional focus and goal orientation required further consolidation. *High content preparedness* was characterised by sessions with confident, accurate content delivery, consistently fluent and correct language use, and clear instructional intent, with strong alignment between activities and language-learning objectives. Presenters demonstrated secure command of grammar, vocabulary, and pronunciation, enabling them to support learning through meaningful and professional use of the target language.

Quantitative Analysis of Ordinal TPACK Ratings

In addition to the qualitative content analysis, we examined whether the three TPACK domains (technological, pedagogical, and content knowledge) were mutually related in presenters' ratings. Each presenter was rated on a three-point ordinal scale (3 = high, 2 = moderate, 1 = low; see Appendix B). Because these scores are ordinal with many ties, we quantified associations primarily with Kendall's tau-b, a nonparametric measure of ordinal association that adjusts for ties and report two-sided p-values from Monte Carlo permutation tests (20,000). As a sensitivity check, we also computed Spearman's rank correlation (ρ) with the same permutation-based p-values. All analyses were performed in Python (pandas) with custom code for permutation tests; the alpha level was set at 0.05.

Ethical Considerations

The research adhered to ethical standards, including informed consent, confidentiality, and the right to withdraw, and it was approved by the Ethics Committee of Constantine the Philosopher University in Nitra, Slovakia (Approval No *UKF/310/2026/191013:002*). Participants were informed of the study's aims and procedures, and their consent was obtained before participation. Recorded micro-teaching sessions were used solely for research, with all identifying information anonymised to protect participants' privacy.

Results

This section presents the study's findings on pre-service EFL teachers' preparedness for AI-supported online teaching within the TPACK framework. The results are organised around the three core knowledge domains of TPACK: technological, pedagogical, and content knowledge. Findings for each domain are presented separately, followed by an examination of the relationships among the ratings to provide a more comprehensive understanding of participants' preparedness for AI-enhanced online instruction.

Pre-Service EFL Teachers' Technological Preparedness

Figure 3 shows that technological preparedness varied across participants. As illustrated, 27.27% of presenters (six students) demonstrated ***high technological preparedness***, guiding learners step by step and troubleshooting technical issues during their micro-teaching. In some cases, they combined multiple AI tools, such as Grammarly with AnswerGarden, ChatGPT with

Wordwall.net, Spotlistrs with ChatGPT, or Story Dice with ChatGPT. One highly prepared presenter used a QR code to provide access to a quiz platform and reassured learners by stating, "*I tried it out, and it worked*". These students also provided troubleshooting instructions and alternative solutions for technical problems. For instance, one presenter addressed a screen-sharing issue by suggesting, "*I'll stop presenting, and you'll be able to share your screen*," allowing the learner to display their product.

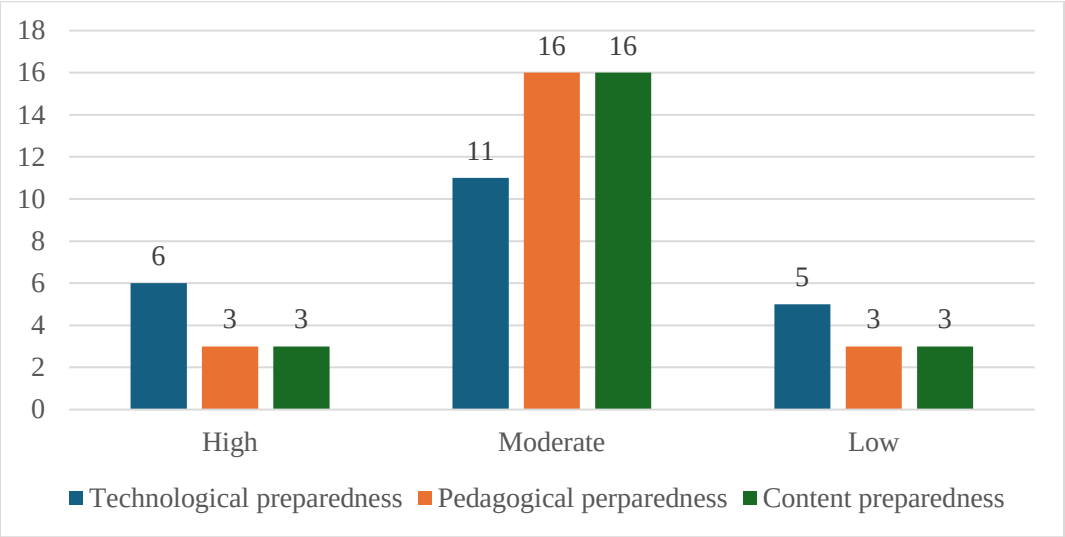


Figure 3. Pre-service EFL Teachers' Technological, Pedagogical and Content Preparedness

Furthermore, 50% of presenters (eleven students) demonstrated **moderate technological preparedness.** For example, when AI tools worked but were not integrated smoothly, instructions were only partly clear, so learners asked for clarification, and technical issues arose, but did not hinder the lesson. One presenter, for instance, instructed learners to imagine they were songwriters and create a song reflecting their mood, directing them to use ChatGPT to help construct the lyrics and then to put a cover of it on Padlet. After learners' questions, they clarified*: "Yes, it should be about your mood. The link to the Padlet is in the chat*." In addition, some presenters interrupted activities to reshow a QR code or adjust their presentation view after learners signalled that the screen was not fully visible. Others acknowledged platform limits *(e.g., "I wanted to put you into break-out rooms for brainstorming, but it is not possible"),* yet improvised workable alternatives, such as *"you can write your ideas in the chat"*.

Low technological preparedness was observed in 22.73% of presenters (i.e., five students). One presenter failed to share the screen and links correctly, remained in editing mode throughout the lesson, and even left the videoconference due to technical difficulties, asking, *"What was the last thing we discussed?"* upon returning. Another told students, *"Feel free to use AI or the Internet,"* without specifying a platform or giving a demonstration. When their video suddenly stopped, instead of offering another solution (e.g., verbally summarising its content), they said, "*Okay, let's just move on to the next activity*." Another student admitted not piloting the required AI tool: *"I never worked with this app before, so I don't know what happens when I press end"*.

Frequent technical issues included echoing or background noise from presenters' microphones, blurred screens, Google Meet pop-up notifications, camera problems (poor

positioning or sudden turn-offs due to connection issues), a QR code blocked by a Google Meet window, and difficulties managing multiple open tabs. Technical problems also stemmed from AI tool requirements; for example, some tools required registration before use, leading some students to decline to participate on security and privacy grounds, stating, "*I'd rather not sign up on that site.*"

Pre-Service EFL Teachers' Pedagogical Preparedness

As shown in Figure 3, 13.64% of sessions (i.e., three students) demonstrated ***high pedagogical preparedness*** and successfully integrated AI-generated visuals into teaching. For example, one used Padlet to teach phrasal verbs, and another used it to introduce a collaborative guessing game. Both applied clear scaffolding from receptive recognition to productive use, including role-play and follow-up tasks. Prompts such as "*no words, let your drawing convey the meaning of the phrase*," tightly linked AI visuals to form-meaning mapping. Furthermore, formative assessment (e.g., "*That's a really creative picture! But can you explain how it reflects the given phrasal verb?*") and platform functions ("*If you have finished, just raise your hand*") were used to monitor progress. Another presenter structured a multi-tool lesson (ChatGPT, Story Dice, Google Docs), and asked learners to "*write down what you found useful*" after the task, deliberately integrating AI feedback into reflective learning.

Moderate pedagogical preparedness was evident among 72.73% of presenters (i.e., 16 students). They showed high potential, using clear instructions and meaningfully implementing AI tools; however, feedback, monitoring, scaffolding, and reflective practice were often absent. For instance, in a story writing micro-teaching session, the presenter used an AI-based storytelling tool but interacted only briefly with one learner, offering only a brief "*Thank you… very creative and did a good job*" as feedback. In another well-planned session, reflection and feedback were omitted due to time constraints: learners were asked to "*put it into ChatGPT*" or upload products to Padlet, and the presenter concluded with "*I think we have no more time, but thank you for participation.*"

Low pedagogical preparedness was observed among 13.64% of presenters (i.e., three students). Scaffolding, feedback, alignment of tools with objectives, and monitoring were absent, and their micro-teaching adopted a teacher-centred lecture style. In some cases, learners were also left to choose their own AI tools, leading to inconsistent quality. For example, one presenter vaguely instructed students, without specifying tools or guidance, saying only: "*With the help of AI or some other application, create your own potion*". Similarly, another participant asked learners to "*choose a real-world threat and use AI to help you brainstorm ideas or create images*".

Also, regarding instructional tone, which is important for creating a trusted learning environment, one presenter used negative reinforcement (mocking students for wrong answers) during a Kahoot quiz, reacting to incorrect responses with comments such as "*Now, you've been caught! Got ya!*" and "*Come on, people!*" Another issue concerned presenters who introduced activities abruptly with "*Ok, let's do the activity now*". Some presenters also showed a lack of confidence through hesitant questions, such as "*Can someone please tell me? Anyone? Come on, at least one person,*" which led to slower or no responses.

Pre-Service EFL Teachers' Content Preparedness

As shown in Figure 3, a ***high content preparedness*** was observed in lessons led by 13.64% of the presenters (three students). The distinguishing feature of these sessions was the integration of subject-matter knowledge with explicit language-learning purposes. These sessions

demonstrated strong alignment among content knowledge, instructional intent, and language-learning objectives, as well as fluent and accurate language use. For example, in the *Introduction to Mindfulness* lesson, the presenter displayed a clear understanding of the topic and selected and justified activities that supported conceptual understanding and learner engagement. Their speech was accurate and coherent, with natural control of English and correct pronunciation, as they guided students through reflection and related vocabulary. Likewise, in another micro-teaching activity, accurate content explanations were reinforced through staged activities, including elicitation, visual input, and a follow-up quiz. The presenter again showed confident, natural delivery and correct pronunciation.

Moderate content preparedness was identified in 72.73% of the presentations (sixteen students). These lessons demonstrated adequate content knowledge and professional delivery, but the language focus was weak, and the links between activities and intended language-learning outcomes were often inconsistent. In the *Alike* lesson, for example, the presenter understood the film's message and used suitable discussion prompts, yet language objectives were not stated. A similar pattern appeared in *Time Travel in Fiction*, where creative tasks reflected familiarity with the topic, but limited follow-up led to poor consolidation of both content and language learning. Although teachers generally controlled content and language, delivery was sometimes mechanical or marked by informal fillers, such as "*I'll give you like five minutes*".

Low content preparedness was observed in 13.64% of the presentations (three students) and was characterised by limited clarity of content, weak linguistic control, and a lack of systematic language focus. For example, in the *Baba Anujka* lesson, language objectives remained unstated and unsupported. Besides, abrupt phrasing such as "*That's really it about Baba Anujka… so let's move to the activity*", together with grammatical and pronunciation problems, illustrated low accuracy and insecure language monitoring. Similarly, the *Cordyceps* lesson mixed factual and fictional elements, resulting in vague tasks and minimal language-focused learning.

Relationships Among Technological, Pedagogical and Content Ratings

Regarding the exploratory aim of assessing mutual relationships among the three domains, pairwise associations showed positive, statistically significant monotonic relationships. Table 1 summarises Kendall's tau-b and Spearman's ρ with permutation-based two-sided p-values (n = 22). Across presenters, 13 of 22 (59%) had identical ratings in all three domains; the most frequent pattern was 2-2-2 (moderate across all; 9 cases).

Table 1. *Ordinal Associations among TPACK domain ratings (two-sided permutation p-values; 20,000 permutations)*

Pair	Kendall's tau-b	p (perm)	Spearman's ρ	p (perm)
TK–PK	0.461	0.034	0.493	0.036
TK–CK	0.461	0.034	0.493	0.036
PK–CK	1.000	< .001	1.000	< .001

As an index of internal consistency across the three domain ratings, Cronbach's alpha was 0.824. Given that pedagogical and content ratings were identical for all presenters in this dataset, this value should be interpreted with caution as it is inflated by redundancy.

Discussion

This study investigated pre-service EFL teachers' preparedness to deliver AI-supported online micro-teaching through the three components of the TPACK framework: technological, pedagogical, and content knowledge.

The ***first research question*** examined the level of technological preparedness demonstrated by pre-service EFL teachers during AI-supported online micro-teaching activities. The findings indicate that most participants demonstrated a moderate level of technological preparedness. Although they were generally able to operate AI tools and incorporate them into their lessons, difficulties frequently arose with smooth integration, providing clear instructions, and troubleshooting technical issues. Only a small proportion of participants demonstrated a high level of technological preparedness characterised by seamless and purposeful integration of AI tools into the teaching process.

The ***second research question*** focused on pedagogical preparedness during AI-enhanced online micro-teaching. The findings revealed that most participants also demonstrated a moderate level of pedagogical preparedness. While AI tools were typically selected appropriately and activities were generally engaging, scaffolding, formative feedback, reflection, and explicit language-learning objectives were often limited or absent. Only a minority of participants demonstrated a high level of pedagogical preparedness in which AI use was fully aligned with learning objectives and supported meaningful learning processes.

The ***third research question*** investigated participants' content-related preparedness in AI-supported online teaching activities. Similar to the previous domains, most participants demonstrated a moderate level of content preparedness. Participants generally possessed adequate subject knowledge and sufficient English language proficiency to conduct their lessons. However, language-learning objectives were often not explicitly emphasised, and only a small number of participants demonstrated the confident, fluent, and accurate language use associated with a high level of preparedness for EFL instruction.

Regarding the ***fourth research question***, which explored whether the three TPACK domains were mutually related based on the researchers' ratings, statistical analysis of the ordinal ratings corroborated the qualitative pattern. Pedagogical and content ratings were perfectly aligned ($\tau_b = 1.00$; $\rho = 1.00$), indicating that in this cohort these two domains were rated identically for every presenter. Technological ratings showed a moderate positive association with both pedagogical and content ratings ($\tau_b = 0.46$, $\rho = 0.49$; both $p < .05$), suggesting that higher technological readiness tended to co-occur with stronger pedagogy and content handling, albeit with notable exceptions. This pattern is consistent with the idea that technological proficiency alone does not guarantee fully integrated TPACK, but it is often present when higher overall preparedness is observed.

Overall, the findings indicate that, across all three dimensions of the TPACK model, a consistent pattern emerged: while most participants demonstrated moderate preparedness, only a small minority achieved a high, fully integrated level of competence, and a comparable minority exhibited low preparedness. Pedagogical and content preparedness, the two most critical domains for future EFL teachers, showed the lowest proportion of high-level performances, while technological preparedness demonstrated the greatest variability among participants.

Regarding technological preparedness, these findings corroborate earlier research suggesting that digital nativeness does not automatically translate into professional digital competence (Pondelíková, 2025; Dolezal et al., 2025). As DigCompEdu (Redecker, 2022) and

Falloon (2020) argue, technological competence encompasses strategic, pedagogical, and ethical dimensions in addition to the ability to use digital tools effectively.

Concerning pedagogical preparedness, only a small proportion of participants used AI in ways that genuinely transformed learning, corresponding to the higher SAMR levels of Modification and Redefinition (Puentedura, 2013). This finding supports the distinction made by Ng et al. (2021) between AI literacy and AI competence. While most participants were able to use AI tools, far fewer demonstrated the ability to integrate them effectively into teaching and learning. Furthermore, the limited evidence of scaffolding and structured monitoring reflects broader challenges documented in EFL contexts, where even experienced teachers often struggle to incorporate AI tools within process-oriented pedagogical frameworks and instead tend to use them primarily as content-generation tools (Al-Azzawi & Saeed, 2026).

In terms of content preparedness, only a minority of participants demonstrated the confident, fluent, and accurate language use required for effective EFL instruction and modelling (Wang et al., 2018). These findings are consistent with Selwyn's (2019) argument that technology cannot compensate for deficiencies in subject-matter knowledge or language competence.

In conclusion, the results strongly confirm the relevance of the TPACK framework (Mishra & Koehler, 2006): effective AI-supported teaching does not result from technological skill alone, but from the integration of technological, pedagogical, and content knowledge. In this cohort, technology was frequently used without being fully embedded in pedagogy or language learning, resulting in fragmented rather than synergistic use of AI. Although a small number of high-preparedness cases demonstrated full TPACK integration, most lessons remained at the "augmentation" stage of the SAMR model (Puentedura, 2013), where AI enhanced existing activities without fundamentally transforming them. Similarly, within Bloom's revised taxonomy of AI literacy (Ng et al., 2021), most pre-service teachers operated at the "applying" or "analysing" levels, experimenting with tools but rarely progressing to the "evaluating" or "creating" levels of pedagogically sound AI-supported learning designs. This pattern is consistent with research identifying recurrent challenges in AI integration, including difficulties in designing lessons that meaningfully incorporate AI tools while simultaneously achieving learning objectives (Alpysbayeva et al., 2025). Such challenges suggest that participants possessed basic technological knowledge but had not yet developed the technological-pedagogical integration necessary for transformative AI-supported instruction. This may stem from participants' prior preparation for predominantly face-to-face instruction, in which AI-supported integration has not yet been systematically embedded, and indicates a need for systematic scaffolding in teacher education to support the development of higher-order AI competence.

The findings also echo broader challenges of online teaching reported during the pandemic (Mahyoob, 2020), while revealing AI-specific barriers such as tool registration requirements, device inequality, and learners' reluctance to engage with AI-generated outputs. These findings closely mirror the challenge clusters identified by Alpysbayeva et al. (2025), namely, technical troubleshooting during lesson delivery and the time-intensive nature of planning AI-integrated activities. From a TPACK perspective, many of these difficulties reflect weaknesses in technological-pedagogical knowledge, as teachers struggled to anticipate technical problems, adapt instruction in response to unexpected disruptions, and design AI-supported activities that maintained pedagogical coherence. In SAMR terms, such disruptions frequently pushed activities back to "substitution," where AI merely replaced traditional materials without adding pedagogical value. In relation to Ng et al.'s (2021) taxonomy, learners and teachers were often limited to

"using" AI, with insufficient support to move toward "evaluating" or "creating." Addressing these issues, therefore, requires not only technical training but also the development of pedagogical, ethical, classroom management, and lesson design strategies that sustain learner engagement, equity, and professional teacher presence (Selwyn, 2019; Rillig et al., 2023).

Accordingly, the findings suggest that EFL teacher education must move beyond introducing AI tools toward fostering TPACK-based AI competence. Pre-service teachers should be trained to design AI-supported lessons that integrate clear language-learning objectives, scaffolding, formative feedback, and opportunities for reflection, rather than relying on AI primarily for content generation. AI pedagogy should therefore be embedded within EFL didactics courses rather than treated as a separate technical skill, enabling future teachers to develop the integrated knowledge required for effective technology-enhanced language instruction. At the same time, the linguistic dimension of content knowledge must remain central, with AI serving to support rather than replace high-quality language modelling. Furthermore, in line with current ethical frameworks (European Commission, 2022; Ng et al., 2021), teacher education programmes should cultivate critical, reflective, and responsible use of AI, enabling future teachers to make informed pedagogical decisions about when AI genuinely enhances learning and when alternative approaches may be more appropriate.

Limitations

This study faced technological and social limitations. Google Meet was selected for its accessibility, but platform-related logistical and technical issues may have influenced session dynamics and data collection. Pre-existing relationships among students also introduced biases: some were more attentive when their friends were delivering micro-teaching activities, while others behaved differently than in a traditional classroom. These dynamics occasionally undermined the formality of the learning environment and the authority typically associated with teaching, potentially affecting the authenticity of the micro-teaching interactions.

Implications for Further Research

The findings of this study suggest several implications for further research. First, given that only a minority of pre-service teachers demonstrated high-level TPACK integration, longitudinal studies could examine how AI-related competence develops over multiple semesters or teaching practicum experiences, clarifying whether gaps in pedagogical and content knowledge diminish with experience or targeted interventions. Second, as pedagogical preparedness emerged as the weakest domain, future research could investigate instructional strategies and scaffolding approaches that support pre-service teachers in moving beyond basic AI tool usage toward designing lessons aligned with SAMR's higher levels (Modification and Redefinition) and Bloom's "evaluating" and "creating" stages of AI literacy. Research could also compare different scaffolding models or AI-focused lesson design frameworks. Finally, future research could explore cross-cultural comparisons to examine whether preparedness patterns, technological-pedagogical challenges, and AI adoption differ across educational or cultural contexts.

Conclusion

This study aimed to evaluate the preparedness of Generation Z pre-service EFL teachers to deliver AI-supported online instruction through the lens of the TPACK framework, based on micro-

teaching sessions delivered by 22 Slovak master's students. Overall, the study shows that while Gen Z pre-service EFL teachers are digitally confident, their readiness for pedagogically sound, language-focused AI-supported teaching remains limited. Technological preparedness showed the greatest variability, with most participants able to operate AI tools but struggling to integrate them smoothly. Pedagogical and content knowledge, the most crucial domains for future EFL teachers, were concentrated mostly at the moderate level, with scaffolding, feedback, explicit language objectives, and reflective practice often absent. AI was frequently used for content generation or task substitution rather than for transformative learning. These findings highlight that effective AI-supported teaching depends on the strategic interplay of technology, pedagogy, and content, rather than digital familiarity alone. Strengthening the integration of these domains in teacher education is therefore essential if AI is to become a meaningful asset in future EFL classrooms. Future research should explore longitudinal development, targeted interventions, learner outcomes, and ethical and equity considerations to support the design of AI-enhanced teacher education that fosters higher-order competence and transformative classroom practice.

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Appendices

Appendix A

Observation Sheet and Criteria

Type of AI tools and alignment with teaching objectives	
Level of effective AI integration	
Overall technological efficiency	
Technical issues and troubleshooting	
Student/teacher centredness	
Clarity of instructions	
Clarity of explanations	
Time management	
Student engagement	
Interaction and support	
Monitoring and feedback	
Content delivery	
Accurate and fluent language use	

Appendix B
Three-point Ordinal Scale of Students' Preparedness

P	TK	PK	CK
Presenter 1	High	Moderate	Moderate
Presenter 2	Moderate	Moderate	Moderate
Presenter 3	High	Moderate	Moderate
Presenter 4	Low	Moderate	Moderate
Presenter 5	High	Moderate	Moderate
Presenter 6	Low	Low	Low
Presenter 7	Moderate	Moderate	Moderate
Presenter 8	Moderate	Moderate	Moderate
Presenter 9	Moderate	Moderate	Moderate
Presenter 10	Low	Moderate	Moderate
Presenter 11	Moderate	Moderate	Moderate
Presenter 12	Moderate	Moderate	Moderate
Presenter 13	Low	Moderate	Moderate
Presenter 14	Low	Low	Low
Presenter 15	High	High	High
Presenter 16	Moderate	Moderate	Moderate
Presenter 17	Moderate	Low	Low
Presenter 18	Moderate	High	High
Presenter 19	Moderate	Moderate	Moderate
Presenter 20	Moderate	Moderate	Moderate
Presenter 21	High	Moderate	Moderate
Presenter 22	High	High	High
	High:6; Moderate:11; Low:5	High:3; Moderate:16; Low:3	High:3; Moderate:16; Low:3

Appendix C
Three-point Evaluation Rubric Criteria

	High	Moderate	Low
TK	- Confident, error-free operation of AI tools and online platforms - Efficiently navigated between tools - Provided precise technical instruction (how to access, submit, interact) - Resolved technical issues independently	- Successfully operated AI tools but with minor hesitations - Required additional clarification of technicals steps - Encountered small technical problems but resolved them - Demonstrated basic understanding of AI	- Struggled to operate AI tools or platforms - Provided unclear or incomplete technical instructions - Unable to resolve technical problems independently - Appeared confused when switching between tools

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	- Demonstrated understanding of AI functionality - Used digital features appropriately - Managed multiple tools/tabs without confusion	tool features but did not optimise them - Managed digital environment but not fluently	- Demonstrated limited understanding of AI functionality - Allowed technical issues to interrupt lesson flow
PK	- Clearly articulated learning objectives - Logical task sequencing (scaffolding) - Appropriate cognitive load management - Active learner engagement strategies (pair work, discussion, collaborative tasks) - Formative assessment - Reflection - Effective classroom management	- Learning objectives implied but not explicitly articulated - Lesson structured but sequencing lacked depth or coherence - Some engagement strategies used but inconsistently - Limited formative assessment or feedback - Reflection was minimal or rushed	- No clear learning objectives - Activities are poorly sequenced or disconnected - Teacher-centred delivery dominated - No scaffolding or progression - No formative assessment or reflection - Weak classroom management
CK	- Accurate and confident handling of the topic - Strong alignment between content focus and explicit language-learning objectives - Precise explanations of grammar, vocabulary, and discourse features - No observable grammatical, lexical, or conceptual inaccuracies	- Generally accurate handling of topic content with minor simplification - Implicit or partially articulated links between content and language-learning goals - Adequate but not fully developed explanation of grammar, vocabulary, and thematic concepts - Occasional linguistic imprecisions	- Limited clarity and coherence in topic presentation - Weak or absent alignment between content and language-learning objectives - Inaccurate explanations of linguistic or thematic concepts - Weak control of subject matter - Frequent linguistic imprecisions