Evaluating English Teachers' Artificial Intelligence Readiness and Training Needs with a TPACK-Based Model

Kevin Kai-Wing Chan[1]& William Ko-Wai Tang[2]

[1] Lecturer (Part-time) and EdD Student, School of Education and Languages, Hong Kong Metropolitan University, Hong Kong

[2] Acting Head of Education, School of Education and Languages, Hong Kong Metropolitan University, Hong Kong

Correspondence: Kevin Kai-Wing Chan, Lecturer (Part-time) and EdD Student, School of Education and Languages, Hong Kong Metropolitan University, Hong Kong.

Received: June 23, 2024 Accepted: August 2, 2024 Online Published: August 30, 2024

doi:10.5430/wjel.v15n1p129 URL: https://doi.org/10.5430/wjel.v15n1p129

Abstract

With the rapid development and widespread adoption of artificial intelligence (AI) tools, the implementation of instructional pedagogy has transformed significantly. English teachers need to understand how AI tools can improve their teaching and must acquire the necessary technical and pedagogical knowledge to effectively utilize AI technology. Although the integration of AI into language teaching shows potential benefits, there remains a dearth of comprehensive research on English teachers' perceptions, readiness, and professional development requirements in relation to AI.

To address these knowledge research gaps, our study aims to evaluate English teachers' current understanding of AI tools and their training needs for integrating AI into the English language classroom. Our proposed model uses the technological pedagogical content knowledge (TPACK) framework, which incorporates English language teaching and information literacy contexts. This framework allows for a holistic assessment of teachers' readiness for integrating AI within English language teaching practices.

A study was conducted with a class of preservice English teachers in Hong Kong. An online survey was designed to assess the readiness of English teachers for applying AI tools in the classroom as well as their understanding and level of information literacy. This study helped identify and address potential issues with the survey before launching it to a wider audience. Our findings confirmed the validity and reliability of the instrument and indicated that preservice English teacher participants are generally prepared to integrate AI tools into the English classroom. Corelation analysis was also conducted to assess the relationships among the constructs and showed that technological pedagogical knowledge (TPK) and instructional literacy (IL) were significant predictors of the overall TPACK construct. The study suggested professional training in the selection, implementation and progress monitoring of specific AI tools for English Language teaching; pedagogy design; and the ability to search for appropriate resources for the English classroom. The framework can be enhanced by using a mixed-method approach and incorporating a qualitative study to triangulate the findings. An explanatory sequential design will be recommended to collect quantitative data first, then qualitative data will be collected for further analysis.

Keywords: Artificial intelligence, TPACK model, AI readiness instrument, AI readiness for English teachers, technological pedagogical content knowledge, AI training needs

1. Introduction

Artificial intelligence (AI) is changing the way we live, work and learn (Moorhouse, 2024; Luckin, et al, 2022; Posner & Fei Fei, 2020). *AI* generally refers to the technology that enables computer systems to simulate human performance in reasoning, analyzing, decision-making and self-correcting (Liang et al, 2021). AI applications are used in many different areas, including but not limited to the industrial, government and consumer sectors. Expert systems. robotics, neural networks and natural language processing (NLP) applications are everywhere (Smith & Eckroth, 2017). Robots are popular in process automation, whereas neural networks are applied in speech, vision and text-processing applications and in deep learning models. NLP models are applied in search engines and AI voice assistants. Smith and Eckroth (2017) even argued that AI and machine learning are expected in almost every application. These AI applications were made possible with the rapid growth in computer hardware performance, the convenient acquisition of immense amounts of data from the Internet, the availability of open-source software and the drastic increase in computing power that supports machine learning (Smith & Eckroth, 2017). For example, companies develop self-driving cars and autonomous driving assistance systems by utilizing the latest AI technologies (Tewari, et al., 2021).

1.1 AI in Education and English Language Teaching

AI also holds immense potential for revolutionizing teaching and learning practices in education while offering new opportunities for personalized instruction, adaptive feedback and innovative approaches to curriculum design (Luckin et al., 2022).

In the context of English language teaching, where effective communication skills are essential, the integration of AI becomes particularly significant. Many AI applications have been developed to improve students' language learning and teachers' teaching (Liang et al., 2021; Sari and Han, 2021; Lee, 2020). The main research domains related to AI in language education include writing, speaking, reading and vocabulary acquisition. Some commonly used AI applications include adaptive learning systems, predictive systems, automated marking systems and chatbots (Chiu, 2023). The recent emergence of generative artificial intelligence (GAI) has further shocked the education sector and claims to present a new paradigm shift for teaching and learning. *GAI* refers to the methods that can be used to create new content or ideas, including but not limited to text, code, audio, images and videos that can be expressed in real time (Qadir, 2022). One example is ChatGPT (generative pre-trained transformer) developed by OpenAI. It is a text-to-text generative AI that generates natural and realistic answers throughout a conversation (Baidoo-Anu et al., 2023). ChatGPT was trained on a large dataset of text, including chat logs, forums, social media posts, books and articles, and can generate human-like responses to prompts and questions (Qadir, 2022; Baidoo-Anu et al., 2023). In November 2022, ChatGPT received considerable attention when it was released for testing to the public and over one million people signed up in just five days! Some of the possible applications of ChatGPT in learning and teaching include personalized tutoring, automated essay grading, language translation, generating and solving technical and nontechnical questions and research assistance (Qadir, 2022; Baidoo-Anu et al., 2023; Kim et al., 2019). Chiu (2023) indicated that GAI has changed how students learn, how teachers instruct and assess students and even how institutions adjust their policies accordingly.

However, it is recommended that these generative AI models be used with caution to improve teaching and support students' learning; guidelines and standards should be established for their fair use because these models are not perfect. Some of the limitations include lack of human interaction, limited understanding of the concepts, bias in training data, lack of creativity, data dependency, lack of contextual understanding, limited personalized instruction and privacy (Alshater, 2023; Baidoo-Anu et al., 2023). Furthermore, it is important to realize that AI applications should only be used to supplement teachers and not to replace them (Celik, 2023; Dikli, 2006).

1.2 Are English Teachers Ready for AI?

With the rapid development of AI tools and the increasing adoption of AI, the implementation of instructional pedagogy has changed significantly (Celik, 2023). Teachers need to recognize how these AI tools can help them in their teaching. They must also learn how to deploy AI technology effectively and attain sufficient technical and pedagogical knowledge to use AI applications. Although AI will not replace teachers in the future (Hrastinski et al., 2019), learning and teaching will be loaded with AI and its related technologies (Ng et al., 2021). For example, an article in the *Times* stated that almost half the students at Cambridge University had used ChatGPT for their studies, just several months after its launch (Sleator, 2023). Some researchers may argue that AI applications have not been proven to be effective in educational contexts (Chiu, 2023), but teachers should still be equipped with AI-based technological and pedagogical knowledge to prepare themselves for the next big wave.

Thus, there is an urgent need to better understand the current readiness of our language teachers and determine how we can help prepare them with the competencies and support needed to integrate AI tools into their classrooms (Luckin, et al., 2022). This may include the ability to distinguish properly designed and ethical AI from those that are not. This need highlights how important IL is for teachers and students who use, provide and communicate information effectively, ethically and responsibly, and who must recognize the ethical issues arising from the application of emerging and advanced information technologies (EDB, 2022).

Although research has emphasized the potential benefits of AI integration into education and language teaching, limited attention has been given to evaluating English teachers' readiness and training needs specifically in relation to AI integration (Moorhouse, 2024; Celik, 2023). There is a dearth of comprehensive studies on understanding teachers' perceptions, readiness, and professional development requirements. These knowledge gaps (Miles, 2017) should be explored further because these components are essential to ensuring the successful integration of AI tools and techniques into English language teaching contexts.

1.3 TPACK Models to Measure English Teachers' AI Readiness

Celik (2023) developed a scale to measure teachers' knowledge pf instructional AI use based on the TPACK framework with ethical aspects. The TPACK model (Mishra & Koehler, 2006) is a robust framework that can be used to measure teachers' professional ability to effectively integrate technology into their teaching. The TPACK framework describes how content and pedagogy form the basis for any effective technological integration in education. The TPACK framework is flexible, allowing researchers to use it for various technological and pedagogical implementations. Celik (2003) adopted the TPACK framework to evaluate the knowledge and skills needed to use AI tools, whereas Valtonen et al. (2017) used TPACK for twenty-first-century skills including problem solving, collaboration, innovative thinking and ICT usages. Moorehouse (2024) conducted a qualitative study to measure beginning teachers and first-year English teachers' GAI readiness, utilization of GAI tools in their language classrooms and ideas on how to integrate GAI tools effectively. The study called for the development of English teachers' GAI competence for teaching and also for the regular tracking of teachers' GAI readiness to cope with the rapid development and adoption of GAI tools.

2. Objectives of This Study

Given the research gaps described above, the purpose of this study is to evaluate Hong Kong English teachers' understanding of AI tools and resources by examining the intersection of their technological knowledge (TK), content knowledge (CK) and technological content knowledge (TCK), while determining the training needs for AI integration into the English language classroom. We will focus on AI tools that can help improve students' productive skills, i.e. speaking and writing skills.

2.1 Technological Knowledge (TK)

We will assess English teachers' TK related to AI tools by examining their familiarity and proficiency with using technology in general. This can include assessing their comfort level using digital devices, online platforms and software applications. It can be done through self-assessment surveys, interviews or lesson observations.

2.2 Content Knowledge (CK)

We will evaluate English teachers' CK in relation to the specific subject matter they teach, such as English language receptive or receptive skills, grammar, or specific modules and themes. This can be achieved through interviews, assessments or discussions about the curriculum and instructional materials. Then we can assess their understanding of the teaching content and evaluate their ability to align it with AI tools and related resources.

2.3 Technological Content Knowledge (TCK)

We will examine English teachers' TCK, which refers to their understanding of how technology can be effectively used to support specific content areas. In the context of AI, this involves assessing their awareness and understanding of AI tools and resources that can enhance English language instruction. This can be done through interviews, surveys or lesson demonstrations.

By conducting a comprehensive assessment, this study seeks to identify the current state of teachers' readiness to use AI technologies, their attitudes toward AI integration, and their perceived challenges and opportunities in utilizing AI in the English language classroom. Through this evaluation, the research aims to provide constructive insights that inform the development of effective professional development programs tailored to address teachers' specific training needs. We will also evaluate whether there are any major differences in the readiness and training needs among preservice and in-service teachers in this research.

The evaluation will be guided by the TPACK framework. The TPACK framework provides a comprehensive view to understand the complex dynamics involved in integrating AI within English language teaching practices, enabling a holistic assessment of teachers' readiness across these dimensions.

We will also incorporate IL as an additional dimension for evaluating and using AI language tools effectively and ethically. IL helps students and teachers identify the need for information; locate, evaluate, extract, organise and present information; create new ideas; cope with the dynamics in our information world; use information ethically; and refrain from immoral practices such as cyber bullying and intellectual property rights infringement (EDB, 2022). In his study, Celik (2023) discussed multiple ethical issues involved with integrating AI applications into teaching and learning. For example, AI-based applications may lead to discrimination and fairness issues. Borenstein and Howard (2021) also argued that there could be bias in the data or algorithms in AI applications because the data collected may not be appropriate or the algorithms used by the AI may be fallible. They propose that ethics instruction should be prioritized in AI education and adoption. Not only must AI developers develop applications ethically, but teachers must also adopt AI applications ethically. In addition, Celik (2023) suggested that teachers should have the knowledge to comprehend, justify and assess AI tools and their results. Furthermore, Tang (2018) conducted a study to measure undergraduate freshmen's IL skills and found that participants were weak in all information literacy areas. IL should therefore be evaluated along with AI readiness and the training needs of our English teachers.

By assessing English teachers' AI readiness, information literacy and training needs, this research contributes to the literature on AI integration in education, specifically in the context of English language teaching. The findings of this study will offer practical recommendations for designing and implementing professional development programs that equip English teachers with the knowledge, skills and confidence to effectively integrate AI technologies into their pedagogical practices. By empowering English teachers to harness the potential of AI in language instruction, we can enhance students' learning experiences, foster their language and communication skills and prepare them for success in the digital age.

This study was conducted to validate the online survey designed to evaluate the level of English teachers' readiness for integrating AI into the classroom. It also examined the level of preservice English teachers' information literacy skills and their relationship with AI readiness. This study helped identify and address potential issues of our instrument before we present it to a wider audience for analysis on a larger scale and at a later stage.

3. Literature Review

3.1 AI in Education (AIED)

AI refers to the development of computer systems that can perform tasks typically requiring human intelligence. It involves the creation of algorithms and models that enable machines to understand, learn, reason and make decisions based on data (Liang et al, 2021). In 1956, John McCarthy from MIT introduced the term *artificial intelligence* during the inaugural academic conference on the topic.

AI has emerged as a powerful technology with the potential to revolutionize various industries, including education. In recent years, AI has gained significant attention in the field of education, offering new tools and approaches to enhance teaching and learning:

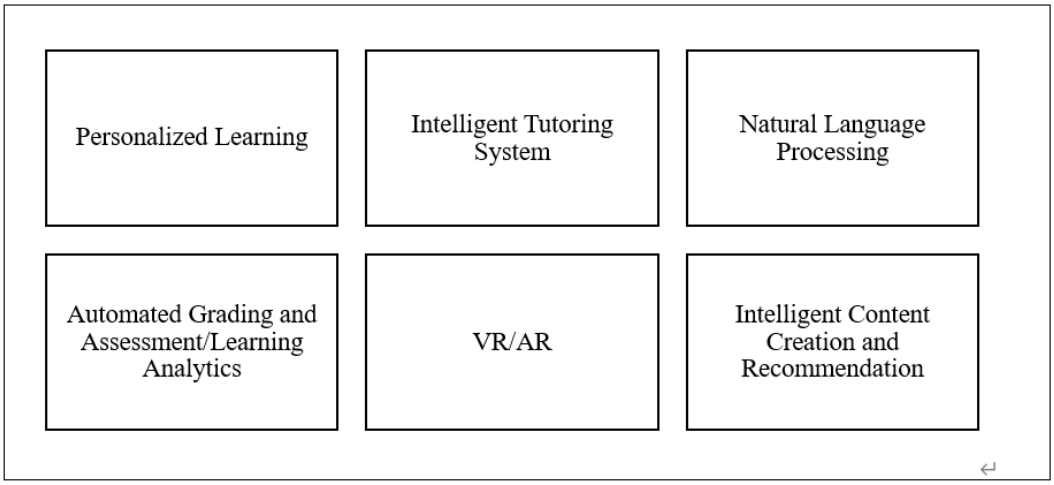

Figure 1. Common Applications of AI in Education

AI technologies enable personalized learning experiences tailored to individual students' needs, abilities and learning styles. Machine learning algorithms analyze student data, including performance, preferences and progress, to provide personalized recommendations, adaptive content and targeted feedback (Chen et al., 2020). Intelligent tutoring systems (ITSs) utilize AI techniques to provide individualized instruction and support to students (Ironsi, 2024). These systems can analyze student inputs, assess their knowledge gaps and deliver tailored feedback and guidance. ITSs have shown promising results in improving student engagement, knowledge retention and academic achievement across various subjects (Liang, et al. 2021).

Natural language processing (NLP) and conversational agents, such as chatbots, have been integrated into educational platforms to facilitate interactive and personalized learning experiences (Murugesan & Cherukuri, 2023). These technologies enable students to ask questions, receive instant feedback and engage in natural language-based conversations, enhancing their understanding and problem-solving skills (Fanni et al., 2023).

AI-based automated grading and assessment systems can efficiently assess and provide feedback on student assignments, exams and essays (Dikli, 2006). These systems utilize machine learning algorithms to analyze and interpret student responses, saving the teachers' time and providing timely feedback to students. AI techniques can also enable the analysis of large-scale educational datasets, uncovering valuable insights into student behavior, learning patterns and performance. Educational data mining and learning analytics help educators identify at-risk students, track progress and make data-informed decisions to improve instruction (Vitartas et al., 2016).

AI-powered VR and AR technologies have gained traction in education, providing immersive and interactive learning experiences (Ironsi, 2024). These technologies enable students to explore virtual environments, visualize complex concepts and engage in hands-on simulations, fostering deeper understanding and knowledge retention (Smith & Eckroth, 2017).

Generative AI algorithms can generate educational content, such as quizzes, lesson plans and learning materials, based on specific learning objectives and student needs (Chen et al. 2020). Additionally, AI-powered recommendation systems suggest relevant resources, courses and activities to support personalized learning journeys.

3.2 AI in English Language Teaching and Learning

The *English Language Education Key Learning Area Curriculum Guide* in Hong Kong suggests that we should develop students' competence in the skills of listening, speaking, reading and writing. This allows students to communicate effectively in English both inside and outside the classroom. Students should also become motivated, independent and responsible for their own learning. Schools are also recommended to create a language-rich environment for students to use and practice English for communication in meaningful contexts (CDC, 2017). We would like to examine how AI is making an impact on English language teaching and learning.

AI-powered ITSs provide personalized instruction and feedback to learners. These systems analyze individual learner data, including language proficiency, learning style and performance, to deliver tailored lessons and exercises. ITSs can identify learners' areas of weakness, provide targeted practice activities and adapt the learning content to their specific needs (Liang, et al. 2021).

AI-based speech recognition technology can help learners improve their pronunciation and speaking skills. Learners can practice speaking aloud, and the system provides real-time feedback on pronunciation accuracy and intonation. This enables learners to receive immediate feedback and work on specific areas of improvement. AI can mimic real-life conversations and allow students to practice the language in meaningful contexts (Ironsi, 2024).

NLP techniques are used to develop AI tools that assist learners with writing tasks. These tools can analyze learners' written work; provide feedback on grammar, vocabulary and sentence structure; and suggest improvements. NLP-based writing assistants can help learners enhance their writing skills and develop more accurate and coherent English language compositions (Dikli, 2006). One example

is ETS's e-rater software. The e-rater engine scores essays by using AI and NLP methods to extract a set of features representing important aspects of writing quality from training essays that are prescored by expert human raters (Quinlan et al., 2009). The features include grammar, usage, style, organization, development, lexical complexity and content (topic-specific vocabulary usage). These features are then combined in a statistical regression model to produce a score, with the weight of each feature determined by a statistical process designed to mimic human scoring. The weighting of features during the scoring process can work in a topic-specific, prompt-specific or generic model. The e-rater scoring engine has been used for summative (scoring) and formative assessments (feedback) and has a high tendency to agree with human raters.

In addition, AI is also used to create adaptive learning platforms that personalize the learning journey for each learner. These platforms use AI algorithms to analyze learners' performance, progress and preferences. They then adapt the learning content, pace and difficulty level to match the learners' needs, ensuring an individualized and optimized learning experience (Ironsi, 2024). Some of these platforms also incorporate gamification elements to make learning more stimulating and interactive (Deterding et al., 2011). These elements include point systems, badges, leaderboards and extra challenges.

3.3 Generative AI in English Language Teaching and Learning

With their ability to generate writing that closely mimics human language and their capacity for multiple ongoing conversations, GAI tools like ChatGPT can aid in open education by providing personalized support, direction and feedback to increase students' motivation and engagement. GAI involves the ability for the AI to produce creative, multimodal content and works of art, including text, music, graphics, audio, videos and even conversations (Hsu & Ching, 2023).

AI-powered virtual language assistants and chatbots engage learners in conversational interactions to practice language skills and receive immediate feedback. These interactive agents use NLP techniques to understand learners' inputs, answer questions, engage in real-life dialogues, and provide language support. They can simulate real-world language conversations and offer a low-pressure environment for learners to practice and reinforce their speaking and listening skills (Moorhouse, 2024). GAI models can also generate text, including stories, essays and dialogues, and students can use these models to practice their writing and improve their creativity.

AI technologies are also used for automated language assessment and placement tests (Ironsi, 2024). These assessments can evaluate learners' language proficiency levels accurately and efficiently. AI algorithms analyze learners' responses, both written and spoken, to determine their language skills and place them in appropriate learning levels or courses.

3.4 How do GAI Tools Align with Language Skills?

The following table summarizes how GAI models can help develop students' language skills (Irsonsi, 2024):

Table 1. How GAI tools are used in English Language Teaching and Learning

Skill	GAI Approach(es)	Reference(s)
Vocabulary	* Personalized vocabulary exercises	Gimpel et al., 2023
	* Contextualized vocabulary learning	Dwivedi, et al. 2023
	* Multimodal vocabulary learning	Ironsi, 2024
Speaking	* AI model to assess pronunciation, fluency and intonation with personalized feedback	Atlas, 2023 Limo et al., 2023
	* Contextualized interactions without the time and space constraints	Lin et al., 2023
	* Natural language creation in context	Pearce et al., 2023
	* Lower speaking anxiety within the AI speaking environment	
Writing	* AI-generated writing prompts with personalized and real-time feedback to motivate students to write more	Liu et al., 2021 Yan, 2023
	* AI-created content to assist in idea generation and process writing steps	
Reading	* AI-generated reading comprehension, cloze and related tasks	Moorhouse, 2024
	* AI-powered speech recognition system and virtual assistants to evaluate students' reading fluency	Liu et al., 2021
Listening	* AI-generated contextualized, diverse and authentic audio content	Tai and Chen, 2021
	* AI-generated listening models and interactive activities	Liu et al., 2022

3.5 Concerns and Challenges of AI in English Language Teaching and Learning

AI applications have the potential to offer numerous benefits for English language teaching and learning, but they also give rise to significant concerns and challenges. The following section describes some major concerns:

Ironsi (2024) identified the accuracy and reliability of AI tools as two major concerns. Because GAI is trained with vast amounts of data, the quality of the training data determines the accuracy and reliability of its output. The AI model may provide grammatically correct yet improper answers because of the ambiguity of human language and the insufficient contextual knowledge of the model. In addition, AI applications may reduce the level of human interaction and interpersonal skills needed in language learning. Overuse of AI tools may create the perception that human teachers are no longer needed in the language learning process. It may also reduce the information processing, writing and critical thinking skills of the students, because they overly rely on the AI models to generate content for them. Students' English skills may decline as a result (Mooreland, 2024; Wu, 2024).

There is also the potential issue of the digital divide (Wu, 2024), because not all students have equal access to the technology and infrastructure needed by the AI applications. Furthermore, AI applications may cause ethical issues including data privacy and security concerns. Students' and teachers' personal information and students' language proficiency and progress may be exposed if not handled carefully by the AI applications. The AI models may also cause bias and fairness issues (Wu, 2024) because the training data used by the AI models may contain incomplete or biased data. Some may even argue that AI tools used in English language teaching and learning promotes plagiarism. Teachers should therefore make sure students use the AI-generated content effectively, ethically and responsibly (Ironsi, 2024). This also implies teachers and students should develop information literacy skills before integrating AI tools in the English classroom.

3.6 Adequately Preparing English Teachers for AI Integration Is the KEY!

Pokrivčáková, (2019) stated that language teachers must be adequately prepared before they can properly integrate AI tools into the language classroom and realize their benefits. However, Mooreland (2024) found that beginning English teachers were not prepared to use GAI tools in their classrooms and knew very little about them. De la Vall and Araya (2023) suggested that professional development programs, mentorship, and collaborative learning methods to prepare language teachers for AI applications should be used in the English classroom. Mooreland (2024) also indicated there is an urgent need to assess the readiness of language teachers to integrate AI tools effectively. If we can better understand teachers' readiness, we can help define teachers' training needs and develop professional development programs accordingly.

The sixty-four-thousand-dollar question is: How can we measure English teachers' AI readiness?

3.7 How can we Measure English Teachers' AI Readiness?

Luckin, et al. (2022) described AI readiness as the ability of teachers and students to understand what AI is and how AI can help them. AI readiness for English teachers (Mooreland, 2024) refers to the level of preparedness and skills that English teachers possess to effectively integrate and utilize AI technologies in their teaching practices. It involves the ability to adapt and leverage AI tools and resources to enhance the teaching and learning experience in the English language classroom.

Mooreland (2024) used a qualitative approach to measure beginning and first-year language teachers' AI readiness for integrating AI tools into the English classroom by conducting interviews with selected groups of teachers. He noted that beginning teachers did not feel ready to incorporate AI tools into their teaching practices. The study only evaluated teachers' perception of AI tool integration and did not guarantee actual implementation by teachers in the classroom. And the relatively small sample size (27 participants) made it difficult to generalize the findings. Lesson plan and class observations were suggested in future studies. The study also recommended training be provided to foster teachers' GAI competence for teaching.

Kaplan, et al. (2023) conducted a quantitative study to investigate teachers' perceptions of GAI and its potential integration into education. The instrument used in the study was an online survey adopted from Wozney. More than half the participants agreed that they would be willing to integrate AI into their English classroom. One third of the participants expressed concerns that AI would replace human teachers. The study also suggested that increased awareness of AI among teachers would likely enhance the AI integration. Kaplan, et al. therefore emphasized the need for preservice teacher training and professional development to increase teachers' exposure and awareness of AI. Teachers will become more confident and more likely to turn their perceptions into actions. However, this study did not focus on English language teachers or tools designed specifically for English language teaching.

Celik (2023) developed an Intelligent-TPACK scale to measure teachers' knowledge and perception of AI tools. His scale was based on the TPACK framework, and the ethical aspects were added as contexts. He also studied the relationships of various TPACK and ethical domains; 428 teachers participated in the study, and results indicated that teachers' AI-specific technological and pedagogical knowledge is the most important component to integrate into their teaching practices. Teachers should also be aware of the potential ethical issues resulting from AI integration. The study has implications for teachers' professional development programs, especially topics on technological and pedagogical knowledge and ethical awareness of AI tools. It is also suggested that preservice teachers be trained on what AI is and how it works before they are trained on the ethical aspects of AI integration. Celik recommended further qualitative studies be conducted to triangulate such findings.

Ning et al. (2024) developed another scale based on the TPACK framework to integrate TPACK and AI technology (AI-TPACK). This framework contains seven domains: pedagogical knowledge (PK), content knowledge (CK), AI-technological knowledge (AI-TK), pedagogical content knowledge (PCK), AI-technological pedagogical knowledge (AI-TPK), AI-technological content knowledge (AI-TCK), and AI-TPACK. The study used exploratory factor analysis and confirmatory factor analysis to study the interplay of these seven knowledge domains. The study indicated that all seven domains are predictive factors for AI-TPACK variables. This study needed additional qualitative data to further validate the model.

3.8 What is TPACK?

The TPACK model is a framework that describes the knowledge and skills that teachers need to effectively integrate technology into their teaching practices. It recognizes that effective technology integration requires more than just technical skills or content knowledge alone (Mishra & Koehler, 2006). Not only does the TPACK model focus on the three primary forms of knowledge, namely CK, PK, and TK, it also highlights the intersections of these domains: PCK, TCK, TPK, and TPACK. The TPACK model emphasizes the importance of

teachers' ability to integrate technology in a way that aligns with their pedagogical and content goals. It recognizes that effective technology integration requires a thoughtful and purposeful approach that considers the unique needs of students and the specific learning objectives of a subject.

The TPACK model has gained significant attention in educational research and practice since 2006 because of its comprehensive nature, contextual relevance, focus on pedagogical transformation and its ability to guide teacher professional development and research efforts in technology integration. The TPACK model provides a comprehensive framework that acknowledges the complex interactions between technology, pedagogy and content knowledge. It goes beyond focusing solely on technological skills and recognizes the importance of integrating technology effectively into pedagogical practices and content-specific contexts. The TPACK model recognizes the importance of considering the specific context of teaching and learning. It acknowledges that effective technology integration depends on the unique characteristics of the subject matter, the learners and the instructional goals. The model can be adapted to different educational and contextual settings (Celik, 2023; Ning et al., 2024). In addition, the TPACK model is a teacher-centered approach and emphasizes the importance of teachers' knowledge, skills and attitudes for leveraging technology effectively. The TPACK model further encourages pedagogical transformation by promoting innovative and student-centered approaches to teaching and learning.

In addition, the TPACK model helps identify teachers' strengths and areas for growth, guiding targeted training and support (Celik, 2023). Finally, the TPACK model has been extensively used in different research studies on technology integration. The model has provided a common language and framework for studying technology integration in different educational contexts.

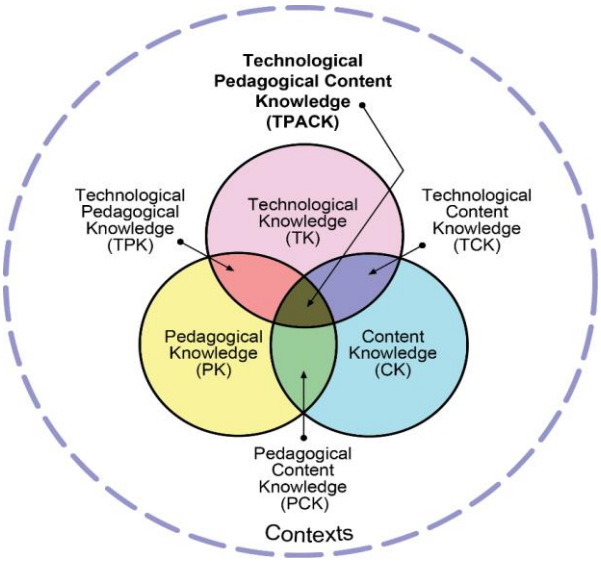

Figure 2. The TPACK Model (reproduced by permission of the publisher, © 2012 by tpack.org)

3.9 Information Literacy (IL) Framework in Hong Kong

Hong Kong's IL learning framework includes the following nine literacy imperatives (EDB, 2022): 1) use, provide and communicate information effectively, ethically and responsibly; 2) identify and define a need for information; 3) locate and address relevant information; 4) evaluate information, media content, and information sources and providers; 5) extract and organize information, and create and present new ideas; 6) apply IT skills to process information and produce user-generated content, and use a reflective mindset when sharing information; 7) recognize the roles and functions of information providers in society; 8) recognize the conditions under which reliable information can be retrieved; and 9) recognize the ethical issues arising from the application of emerging and advanced information technologies. Given the concerns and challenges of AI integration into English language teaching and learning (described in previous sections), students and teachers need to be proficient in these nine literacy areas to effectively incorporate AI applications into the English classroom. This study attempts to measure the current IL of English teachers so that a baseline can be established for further investigations at a later stage.

3.10 Other Models to Consider

3.10.1 Technology Acceptance Model

The technology acceptance model (TAM; Davis, 1989) is a framework used to explain and predict individuals' acceptance and adoption of new technology. The TAM model indicates that perceived usefulness, perceived ease of use and attitude toward technology use are three fundamental variables that determine the success of technology implementations. This model tends to focus on the users' acceptance and adoption of the technology. Content and pedagogical considerations may not receive the same level of attention in this particular study.

3.10.2 Digital Competence Framework for Educators

The digital competence framework for educators (DIGCOMPEDU) is a framework that outlines the digital competencies needed by educators to effectively integrate digital technologies into teaching and learning. It was developed by the European Commission's Joint Research Centre (JRC). The DIGCOMPEDU model is designed to support educators in developing their digital skills and competencies across different domains of professional practice (Punie, 2017). It recognizes that digital competence goes beyond technical skills and encompasses a range of cognitive, socio-emotional and ethical dimensions (Ng et al., 2023). The model is aligned with the broader European digital competence framework (DigComp), which provides a common reference for digital competence across various sectors. The DIGCOMPEDU model describes 22 competencies. These competences are grouped in six areas, including professional engagement, digital resources, teaching and learning, assessment, empowerment of learners and facilitating learners' digital competence. These competencies are often called *AI competency*. AI competency has emerged as a pivotal skill in the twenty-first century (Ng et al., 2023). The possession of AI competencies can empower individuals to engage in critical evaluations of AI technologies, facilitate effective communication and collaboration with AI systems and harness the potential of AI as a versatile tool across various domains.

DIGCOMPEDU also has a self-reflection tool (Selfie for Teachers with 32 items) to assist teachers in identifying their strengths and areas for improvement in enhancing their digital competencies (Mišianiková et al., 2021). The self-reflection tool can also help determine the learning resources needed by teachers based on their reflection results.

The DIGCOMPEDU model is a broad framework that encompasses various digital competencies for educators. Although it includes AI-related competencies, its focus may not be exclusively on AI integration into English language teaching. The TPACK framework focuses on the intersection of technological knowledge, pedagogical knowledge and content knowledge. The TPACK model is preferred over the DIGCOMPEDU model in this study because the TPACK model can provide a deeper understanding of how teachers can effectively integrate AI technologies within the specific context of English language teaching.

3.11 Why is TPACK with IL Chosen to Measure English Teachers' AI Readiness and Training Needs?

Using the TPACK model and IL to evaluate English teachers' readiness to integrate AI tools into the English classroom offers several advantages:

Comprehensive assessment: The TPACK model provides a holistic framework that considers the integration of technology, pedagogy and content knowledge. By incorporating IL, we can assess teachers' ability to find, evaluate and apply information effectively, including the use of AI tools and resources (Mishra & Koehler, 2006; Ning et al., 2024).

Technological competence: The TPACK model assesses teachers' technological knowledge and skills related to AI tools. IL, on the other hand, focuses on their ability to navigate and critically evaluate the vast amount of information available, which is crucial when integrating AI tools that rely on data and algorithms. Issues including accuracy, reliability and bias, and ethical concerns may arise, and teachers need to have the skills to use the AI content effectively and ethically (Celik, 2023).

Pedagogical integration: The TPACK model emphasizes the pedagogical aspects of technology integration. By combining it with IL, we can assess how well teachers can design meaningful learning experiences that incorporate AI tools while promoting critical thinking, information evaluation and digital literacy skills among students (Mishra & Koehler, 2006).

Content relevance: Both the TPACK model and IL can be tailored to the specific context of English language teaching and learning. By evaluating teachers' readiness to integrate AI tools using these frameworks, we can help ensure that technology integration aligns with the English curriculum, language standards and content-specific goals (Dewi et al., 2021).

Ethical and responsible use: IL encompasses ethical considerations and responsible use of information. When evaluating teachers' readiness to integrate AI tools, this aspect becomes crucial, because AI technologies may raise ethical concerns such as data privacy, bias and algorithmic transparency. Assessing teachers' understanding of these issues can support ethical and responsible integration of AI tools (Celik, 2023; EDB, 2022).

By leveraging the TPACK model and IL, we can ensure a comprehensive evaluation that considers teachers' technological, pedagogical, and content knowledge, as well as their ability to effectively navigate, evaluate and use information in the context of AI integration in the English classroom.

4. Theoretical Framework and Research Questions

Although AI applications in English language teaching have become increasingly popular and accessible, only a limited number of studies specifically examine the assessment of English teachers' readiness in utilizing GAI. Very little is known about their readiness for applying AI technologies in their English classroom, nor about English teachers' training needs. No studies have been conducted to measure English teacher's AI readiness in Hong Kong, Macao, or the Greater Bay Area. Furthermore, it is important for us to measure teachers' information literacy and understanding of the ethical issues that may arise from AI integration into the English classroom. Given these research gaps in English teachers' AI readiness and training needs, we aim to address three research questions in this study.

The following diagrams illustrate the theoretical framework used in the overall study, along with the research questions:

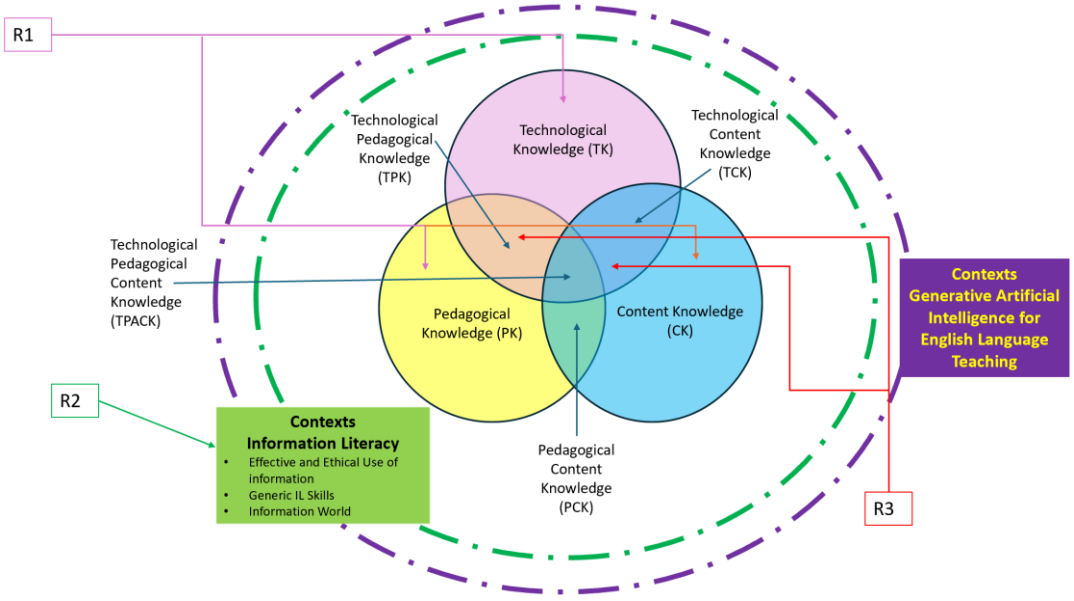

Figure 3. Theoretical Framework of This Study

This framework was adopted from the TPACK model with information literacy and AI for English language teaching contexts.

The above framework allowed us to design and develop an instrument based on TPACK and information literacy, with a focus on AI for English language teaching in context. This instrument should allow us to examine teachers' readiness for AI integration in the English classroom, as well as to identify the training needs of our teachers.

4.1 Research Questions

RQ1: What is the current level of English teachers' AI readiness, in terms of technological knowledge (TK), pedagogical knowledge (PK) and content knowledge (CK)?

RQ2: What is the current level of English teachers' information literacy (IL)?

RQ3: What are the specific training needs of English teachers in terms of AI integration, per technological content knowledge (TCK), technological pedagogical knowledge (TPK) and IL?

Hypothesis of RQ3: H_0 There is no significant relationship between TCK, TPK and IL and the training needs of English teachers in terms of AI integration.

5. Methodology

5.1 Research Method for the Study

Our quantitative research study used an online survey instrument to address RQ1 and RQ2.

This study used a survey instrument adopted from Celik's Intelligent-TPACK instrument (Celik, 2023). Items were customized to focus on English teachers' AI integration; items designed to address the teachers' IL understanding were added. The survey includes closed-ended items with Likert scale options, each item yielding a score of 1 (strongly disagree) to 5 (strongly agree). Items were reviewed by experts in developing AI applications and by in-service English teachers. The items are enclosed in Appendix 1. Demographic information such as age and gender were also collected. Items were designed to cover the following categories:

TK assesses teachers' familiarity with AI tools used in the English classroom and their proficiency in using technology for educational purposes.

TPK evaluates teachers' knowledge of instructional strategies that integrate technology effectively.

TCK examines teachers' awareness and understanding of AI tools and resources that can enhance English language instruction.

TPACK assesses teachers' knowledge of integrating AI tools with instructional strategies in the English classroom effectively and ethically.

IL refers to how teachers and students use, provide, and communicate information effectively, ethically, and responsibly, as well as how they recognize the ethical issues arising from the application of emerging and advanced information technologies.

5.2 Participants

The survey was sent to a class of final-year preservice teachers at a local university in Hong Kong. These students were completing their

double degrees in English language teaching and English language studies. All had completed at least one term of teaching practice at a primary or secondary school, and they had experience integrating IT tools into the classroom. These students could become fully qualified English language teachers in Hong Kong upon graduation. Their feedback is a good representative sample for us to better understand preservice English teachers' readiness in applying AI tools in the English classroom. They can also help identify AI-related training needs for English teachers.

Emails were sent to the participants, and they were asked to complete the survey online. The survey took around 15–20 minutes to complete. A total of 16 participants completed the survey (out of a total of 28 students in the class, representing a 57% completion ratio). The participants' demographics are shown in Table 2.

Table 2. Participant Demographics (n = 16)

Gender	Frequency	Percentage (%)	Attended ____ secondary school	Frequency	Percentage (%)
Female	10	62.5	Chinese as the medium of instruction (CMI)	5	31.3
Male	6	37.5	English as the medium of instruction (EMI)	11	68.8
Wants to become a teacher upon graduation	Frequency	Percentage (%)			
primary school	5	31.3			
secondary school	9	56.3			
vocational school	1	6.3			
none of the above	1	6.3			

5.3 Validity and Reliability Procedures

Three experts in developing AI tools for English language teaching and learning and three English teachers were invited to review the instrument described above. The AI developers had over 10 years of developing such tools and the English teachers had over 10 years of teaching experience. They were invited to review the survey and interview questions as part of the validation procedure. Changes to the survey and interview questions were made based on the feedback from the panel of experts before sending them to our participants.

In addition, we examined the reliability of the instrument developed in this study by evaluating Cronbach's alpha. Results are described in the following section.

6. Results and Discussion

The survey instrument was designed to evaluate English teachers' readiness for integrating AI tools into the classroom. Results (Table 3) indicated that participants scored the highest in the IL construct (M = 4.16, SD = 0.83), followed by the TK construct (M = 4.06, SD = 0.86), TPK construct (M = 4.04, SD = 0.87) and TCK construct (M = 3.91, SD = 0.87). They scored the lowest in the TPACK construct (M = 3.86, SD = .85). The Cronbach's alpha of all constructs was larger than 0.8, indicating that the measurements had strong reliability. The above analysis demonstrates that the results are valid and reliable and provides evidence to address RQ1 and RQ2. The results are different from the findings of Aziz et al., 2022, who used the TPACK model to measure English lecturers' readiness to adopt technological tools in their teaching. They found that the TPK construct had the highest score, followed by TCK and TPACK. TK had the lowest score in their studies. The score differences between the two studies may be explained by the differences in age and the level of training on technological tools used for teaching.

Table 3. Survey Results by Construct and the Corresponding Cronbach's Alpha Values

Construct	No of items	Mean	SD	CA Value
Technological knowledge (TK)	5	4.06	0.86	0.932
Technological pedagogical knowledge (TPK)	7	4.04	0.87	0.939
Technological content knowledge (TCK)	4	3.91	0.87	0.862
Information literacy (IL)	9	4.16	0.83	0.947
Technological pedagogical content knowledge (TPACK)	7	3.86	0.85	0.921

The high score in the IL construct can be explained by the development of the Information Literacy for Hong Kong Students by the Education Bureau (EDB, 2022). IL helps schools develop students' skills to use information and information technology ethically and effectively at different key stages. In addition, IL has been incorporated into the school curriculum since 2018, and students have been applying IL in various key learning areas. Participants of this survey should have been introduced to the IL learning framework in their secondary school studies. They should have had some experience in developing such competency. It would be interesting to evaluate the corresponding IL scores of the in-service English teachers who might not have been introduced to the IL learning framework then.

Participants also obtained high scores in the TK and TPK constructs. These preservice English teachers completed two IT-related courses, namely Information Technology for Learning and Information for Teaching. These two courses should have provided participants with knowledge in using technology tools in learning and teaching contexts. That could explain why they scored higher in these two constructs. They had lower scores in TCK and TPACK because these constructs examine teachers' understanding of AI tools used for

instructional strategies in the English classroom, and the two courses described above did not go into specifics on each subject area when applying IT tools. Without the knowledge and experience needed to apply AI tools in the English classroom, the participants scored lower in the TCK and TPACK constructs. The scores also imply that additional training on the TCK and TPACK constructs will be needed for preservice English teachers.

Table 4. Survey Analysis by Gender across the TK, TPK, TCK, IL and TPACK Constructs

Construct	Female (N = 10) Mean	SD	Male (N = 6) Mean	SD
Technological knowledge (TK)	3.96	0.81	4.23	0.86
Technological pedagogical knowledge (TPK)	4.06	0.85	4.00	0.91
Technological content knowledge (TCK)	3.98	0.89	3.79	0.72
Information literacy (IL)	4.22	0.73	4.05	0.87
Technological pedagogical content knowledge (TPACK)	3.93	0.82	3.74	0.80

Table 4 shows the survey results by gender. T-tests were conducted to determine whether there was a statistically significant difference in the constructs based on gender. Male preservice English teachers (M = 4.23, SD = 0.86) showed significantly higher scores in the TK construct than female preservice English teachers (M = 3.96, SD = 0.81); t(4) = -2.74, p = .05. This is similar to the results of Chai et al.'s (2011) TPACK survey of over 1,100 preservice teachers from Singapore (Chai, et al., 2011) in which male participants scored themselves higher on the TK construct.

However, there were no statistically significant differences in the TPK, t(6) = 0.48, p = .32, and TCK, t(3) = 1.32, p = .14, constructs between female and male preservice English teachers.

Female preservice English teachers scored significantly higher scores on the TPACK and IL constructs. In the TPACK construct, there was a significant difference between female participants (M = 3.93, SD = 0.82) and male participants (M = 3.74, SD = 0.80), t(6) = 2.11, p = .04. In the IL construct, there was a significant difference between female participants (M = 4.22, SD = 0.73) and male participants (M = 4.05, SD = 0.87), t(9) = 2.47, p = .02).

Pearson's correlation was also conducted to assess the relationship among the constructs. The findings are illustrated in Table 5.

Table 5. Pearson's Correlation Among TK, TPK, TCK, IL, and TPACK

Pearson's Correlations										
Variable		TK		TPK		TCK		IL		TPACK
1. TK	Pearson's r	—								
	p-value	—								
2. TPK	Pearson's r	0.917	***	—						
	p-value	< .001		—						
3. TCK	Pearson's r	0.830	***	0.839	***	—				
	p-value	< .001		< .001		—				
4. IL	Pearson's r	0.748	***	0.787	***	0.851	***	—		
	p-value	< .001		< .001		< .001		—		
5. TPACK	Pearson's r	0.778	***	0.900	***	0.725	**	0.818	***	—
	p-value	< .001		< .001		0.001		< .001		—

* p < .05, ** p < .01, *** p < .001.

The above table shows that the strongest positive correlation is between participants' self-perceived TK and their TPK (rs(16) = .917, p < .001), followed by the second-highest positive correlation between their TPK and TPACK (rs(16) = .90, p < .001). The lowest correlation is between TCK and TPACK (rs(16) = .725, p < 0.1). All the correlations measured are positive, and all two variables measured are moving in the same direction together.

In addition, a multiple linear regression was calculated to predict TPACK based on the scores of TK, TCK, TPK and IL. This resulted (Table 6) in a significant model, (F(4, 11) = 21.371, p < .001), with an R^2 of .886. The individual predictors were examined further. Results show that TPK (t = 3.734, p < .01) and IL (t = 2.416, p < .05) were significant predictors, whereas TK (t = -.896, p = .389) and TCK (t = -1.553, p = .149) were not. The results are consistent with the findings of Celik (2023), who found that TK was not associated with TPACK and discovered that TPK was a strong predictor of TPACK. This could be explained by the difference in demographics and level of technology training received by the participants in the study.

Table 6. Multiple Linear Regression Model

Model Summary—TPACK				
Model	R	R^2	Adjusted R^2	RMSE
H_0	0.000	0.000	0.000	0.688
H_1	0.941	0.886	0.845	0.271

ANOVA						
Model		Sum of Squares	df	Mean Square	F	p
H_1	Regression	6.292	4	1.573	21.371	< .001
	Residual	0.810	11	0.074		
	Total	7.102	15			

Note. The intercept model is omitted, because no meaningful information can be shown.

Coefficients						
Model		Unstandardized	Standard Error	Standardized	t	p
H_0	(Intercept)	3.857	0.172		22.422	< .001
H_1	(Intercept)	0.175	0.463		0.378	0.712
	TK	-0.224	0.250	-0.239	-0.896	0.389
	TPK	0.954	0.255	1.044	3.734	0.003
	TCK	-0.357	0.230	-0.366	-1.553	0.149
	IL	0.514	0.213	0.485	2.416	0.034

To address RQ3, the study results indicated that preservice English teacher participants are generally prepared to integrate AI tools in the English classroom, and the following items have an average score lower than 3.9.

Table 7. Items with an Average Score Lower Than 3.9 by Construct (n = 16)

Construct	Item	Mean	SD
TK	4. I have sufficient knowledge to use AI-based tools.	3.88	0.89
TPK	9. I know how to use AI-based tools to monitor students' English language learning progress.	3.88	0.89
TPK	11. I can understand alerts (or notifications) from AI-based tools to scaffold students' learning.	3.88	0.81
TCK	14. I am aware of various AI-based tools that are used by professionals in English language teaching.	3.69	0.70
TPACK	17. I know how to use different AI-based tools for adaptive feedback in English language teaching.	3.81	0.75
TPACK	20. I can teach English language using AI-based tools with diverse teaching strategies.	3.81	0.75
TPACK	21. I can teach English lessons that appropriately combine my teaching content, AI-based tools, and teaching strategies.	3.88	0.96
TPACK	22. I can take a leadership role among my colleagues in the integration of AI-based tools into our English classrooms.	3.81	0.98
TPACK	23. I can select various AI-based tools to monitor students' learning in my teaching process.	3.81	0.83
IL	24. I am confident in identifying the most appropriate sources of information for a research question or task.	3.81	0.75
IL	25. I feel comfortable using advanced search techniques to locate relevant information in online databases and other sources.	3.88	0.72

The above results suggest that additional training could be provided to the participants, including the selection and implementation of specific AI tools for English language teaching and progress monitoring (items 4, 9, 11, 14, 17, 22 and 23), pedagogies needed to utilize AI tools in the English classroom (items 20 and 21), as well as the ability to search for the right resources to assist teaching (items 24 and 25).

7. Conclusion

The swift development and widespread adoption of AI tools in language education demands that English teachers understand how these AI tools can improve their teaching and help them acquire the necessary technical and pedagogical knowledge. Although the integration of AI into language teaching may show potential benefits, comprehensive research is needed on English teachers' perceptions, readiness, and professional development needs regarding AI.

This study uses an instrument guided by the (TPACK) framework, English language teaching and IL contexts. This instrument was used to assess teachers' readiness in integrating AI within English language teaching practices. The study was conducted with a class of preservice English teachers in Hong Kong. The study used a quantitative approach to to assess the readiness of English teachers in applying AI tools in the classroom as well as their understanding and level of IL. Our findings confirmed the validity and reliability of the instrument. The results also indicated that preservice English teachers are generally prepared to integrate AI tools into the classroom (RQ1 and RQ2).

Correlation analysis showed that TPK and IL were significant predictors of the overall TPACK construct. The study further suggested the need for additional professional development in the selection and implementation of specific AI tools for English language teaching, pedagogical design incorporating AI and identification of appropriate AI-based resources for the English classroom (RQ3).

This study sets a solid foundation for measuring the AI readiness of preservice English teachers. The framework can be extended to measure the same for in-service English teachers. We can also examine the training needs of both preservice and in-service English teachers and properly prepare them for the AI integration in the English classroom. In addition, we plan to invite teachers from the Greater Bay Area to participate in the next phase of our study. We should be able to understand English teachers' AI readiness in their respective cities. This model can also be used in other cities, and comparative studies can be conducted as a result.

In addition, this model can be extended to measure teachers' AI readiness in other subject areas. Although this instrument focuses on how the AI tools can help English teachers improve students' receptive and productive skills, it can be extended to other subject areas. For example, the instrument can be extended to measure math teachers' readiness to improve students' logical thinking and problem-solving skills.

8. Limitations and Future Research Considerations

This is a small-scale study because the sample size was rather small and only involved preservice English teachers from one class. Future research can invite more preservice and in-service English teachers.

It would be interesting to examine whether there are differences in the AI readiness and training needs among preservice and in-service English teachers. In addition, we can invite teachers in other regions to participate in the study. English teachers in the Greater Bay Area will be invited to participate in the next phase of the study.

This study used a quantitative approach to measure English teachers' AI readiness. An explanatory sequential design is suggested. A qualitative approach could be added to triangulate our findings through interviews, lesson plan analysis, classroom observations and assessment of professional development needs after the quantitative data has been collected. These suggestions should offer practical implications for designing professional development programs and empowering teachers to integrate AI applications for improved student learning.

Acknowledgments

Not applicable.

Authors' contributions

Kevin Kai-Wing Chan is the President of Smart Education and Lecturer (Part-time) of the School of Education and Languages at Hong Kong Metropolitan University. He is currently pursuing his Doctor of Education at Hong Kong Metropolitan University. His research interests include artificial intelligence in education, second language acquisition, ICT in Education and computer-assisted language learning. He holds a Master of Education degree from the Education University of Hong Kong, and a Master of Engineering degree from Cornell University.

William Tang is currently Acting Head of Education and Assistant Professor of the School of Education and Languages at Hong Kong Metropolitan University. He obtained his doctoral and master's degree in Information Technology in Education from The Chinese University of Hong Kong. He is the programme leader of Doctor of Education and Doctor of Education (Chinese). Dr Tang has actively promoted Information Technology in Education by designing and teaching various Information Technology in Education training courses for pre-service and in-service teachers. He has over fifteen years of experience in teacher education at both undergraduate and postgraduate level. He was the recipient of OUHK President's Awards for Teaching Excellence in 2018 and the winner of HKMU President's Awards for Excellence in Inspirational Teaching in the academic year 2022/23. His research interests lie in the area of information literacy and the application of information technology in education.

Funding

Not applicable.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available

due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

References

Alshater, M. (2022). *Exploring the role of artificial intelligence in enhancing academic performance: A case study of ChatGPT* (December 26, 2022). https://doi.org/10.2139/ssrn.4312358

Atlas, S. (2023). *ChatGPT for higher education and professional development: A guide to conversational AI*. The University of Rhode Island.

Aziz, A. A., Aziz, A. A. A., Norwahi, N. A., Nordin, N. A., Zaini, N., Shaidin, S., & Azhar, S. B. H. J. (2022, September). TPACK readiness among English-language lecturers for open distance learning (ODL) adoption in a Malaysian public university. In *Proceedings, 82*(1), 12. MDPI. https://doi.org/10.3390/proceedings2022082012

Baidoo-Anu, D., & Owusu Ansah, L. (2023). *Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning* (January 25, 2023). https://doi.org/10.2139/ssrn.4337484

Borenstein, J., & Howard, A. (2021). Emerging challenges in AI and the need for AI ethics education. *AI and Ethics, 1*, 61-65. https://doi.org/10.1007/s43681-020-00002-7

Celik, I. (2023). Towards Intelligent-TPACK: An empirical study on teachers' professional knowledge to ethically integrate artificial intelligence (AI)-based tools into education. *Computers in Human Behavior, 138*, 107468. https://doi.org/10.1016/j.chb.2022.107468

Chai, C. S., Koh, J. H. L., & Tsai, C. C. (2010). Facilitating preservice teachers' development of technological, pedagogical, and content knowledge (TPACK). *Educational Technology and Society, 13*(4), 63-73.

Chen, X., Xie, H., Zou, D., & Hwang, G. J. (2020). Application and theory gaps during the rise of artificial intelligence in education. *Computers and Education: Artificial Intelligence, 1*, 100002. https://doi.org/10.1016/j.caeai.2020.100002

Chiu, T. K. (2023). The impact of Generative AI (GenAI) on practices, policies and research direction in education: A case of ChatGPT and Midjourney. *Interactive Learning Environments*, 1-17. https://doi.org/10.1080/10494820.2023.2253861

Curriculum Development Council. (2017). *English Language Education: Key Learning Area Curriculum Guide (Primary 1-Secondary 6)*. Hong Kong: Hong Kong Government Printer.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340. https://doi.org/10.2307/249008

De la Vall, R. R. F., & Araya, F. G. (2023). Exploring the benefits and challenges of AI-language learning tools. *International Journal of Social Sciences and Humanities Invention, 10*, 7569-7576. https://doi.org/10.18535/ijsshi/v10i01.02

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: Defining gamification. In *Proceedings of the 15th international academic MindTrek conference: Envisioning future media environments*, 9-15. ACM. https://doi.org/10.1145/2181037.2181040

Dewi, N. R., Rusilowati, A., Saptono, S., Haryani, S., Wiyanto, W., Ridlo, S., ... Atunnisa, R. (2021). Technological, Pedagogical, Content Knowledge (TPACK) Research Trends: A Systematic Literature Review of Publications between 2010-2020. *Journal of Turkish Science Education, 18*(4), 589-604. https://doi.org/10.36681/tused.2021.92

Dikli, S. (2006). An overview of automated scoring of essays. *The Journal of Technology, Learning and Assessment, 5*(1).

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., ... Wright, R. (2023). Opinion paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management, 71*, 1-63. https://doi.org/10.1016/j.ijinfomgt.2023.102642

Education Bureau. (2022). *Information Literacy for Hong Kong Students Learning Framework*. Retrieved from https://www.edb.gov.hk/en/edu-system/primary-secondary/applicable-to-primary-secondary/it-in-edu/information-literacy/il-index.html

Fanni, S. C., Febi, M., Aghakhanyan, G., & Neri, E. (2023). Natural language processing. In *Introduction to Artificial Intelligence*, 87-99. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-25928-9_5

Gimpel, H., Hall, K., Decker, S., Eymann, T., Lämmermann, L., Mädche, A., ... Vandrik, S. (2023). *Unlocking the power of generative AI models and systems such as GPT-4 and ChatGPT for higher education: A guide for students and lecturers* (No. 02-2023). Hohenheim Discussion Papers in Business, Economics and Social Sciences.

Hrastinski, S., Olofsson, A. D., Arkenback, C., Ekström, S., Ericsson, E., Fransson, G., ... Utterberg, M. (2019). Critical imaginaries and reflections on artificial intelligence and robots in postdigital K-12 education. *Postdigital Science and Education, 1*, 427-445. https://doi.org/10.1007/s42438-019-00046-x

Hsu, Y. C., & Ching, Y. H. (2023). Generative Artificial Intelligence in Education, Part One: The Dynamic Frontier. *TechTrends, 67*(4), 1-5. https://doi.org/10.1007/s11528-023-00863-9

Ironsi, C. S. (2024). Exploring the Potential of Generative AI in English Language Teaching. In P. Yu, J. Mulli, Z. Syed, & L. Umme (Eds.), *Facilitating Global Collaboration and Knowledge Sharing in Higher Education With Generative AI* (pp. 162-185). IGI Global. https://doi.org/10.4018/979-8-3693-0487-7.ch007

Kim, S., Park, J., & Lee, H. (2019). Automated essay scoring using a deep learning model. *Journal of Educational Technology Development and Exchange, 2*(1), 1-17.

Liang, J. C., Hwang, G. J., Chen, M. R. A., & Darmawansah, D. (2021). Roles and research foci of artificial intelligence in language education: an integrated bibliographic analysis and systematic review approach. *Interactive Learning Environments*, 1-27. https://doi.org/10.1080/10494820.2021.1958348

Limo, F. A. F., Tiza, D. R. H., Roque, M. M., Herrera, E. E., Murillo, J. P. M., Huallpa, J. J., & Gonzáles, J. L. A. (2023). Personalized tutoring: ChatGPT as a virtual tutor for personalized learning experiences. *Social Space, 23*(1), 293-312.

Lin, C. C., Huang, A. Y., & Yang, S. J. (2023). A review of AI-driven conversational chatbot implementation methodologies and challenges (1999-2022). *Sustainability (Basel), 15*(5), 4012. https://doi.org/10.3390/su15054012

Liu, C. C., Liao, M. G., Chang, C. H., & Lin, H. M. (2022). An analysis of children's interaction with an AI chatbot and its impact on their interest in reading. *Computers & Education, 189*, 104576. https://doi.org/10.1016/j.compedu.2022.104576

Liu, C., Hou, J., Tu, Y. F., Wang, Y., & Hwang, G. J. (2021). Incorporating reflective thinking promoting mechanism into artificial intelligence-supported English writing environments. *Interactive Learning Environments*, 1-19. https://doi.org/10.1080/10494820.2021.2012812

Liu, Y., Mishan, F., & Chambers, A. (2021). Investigating EFL teachers' perceptions of task-based language teaching in higher education in China. *The Language Learning Journal, 49*(2), 131-146. https://doi.org/10.1080/09571736.2018.1465110

Luckin, R., Cukurova, M., Kent, C., & du Boulay, B. (2022). Empowering educators to be AI-ready. *Computers and Education: Artificial Intelligence, 3*, 100076. https://doi.org/10.1016/j.caeai.2022.100076

Miles, D. A. (2017, August). A taxonomy of research gaps: Identifying and defining the seven research gaps. In *Doctoral student workshop: finding research gaps-research methods and strategies, Dallas, Texas*, 1-15.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers college record, 108*(6), 1017-1054. https://doi.org/10.1111/j.1467-9620.2006.00684.x

Mišianiková, A., Hubeňáková, V., Kireš, M., Babinčáková, M., Šveda, D., & Šafárik, P. J. (2021, November). Assessment of digitalization in primary and secondary schools by SELFIE Survey as a part of school leaders training. In *2021 19th International Conference on Emerging eLearning Technologies and Applications (ICETA)*, 252-258. IEEE. https://doi.org/10.1109/ICETA54173.2021.9726580

Moorhouse, B. L. (2024). Beginning and first-year language teachers' readiness for the generative AI age. *Computers and Education: Artificial Intelligence, 6*, 100201. https://doi.org/10.1016/j.caeai.2024.100201

Murugesan, S., & Cherukuri A. (2023). *The Rise of Generative Artificial Intelligence and Its Impact on Education: The Promises and Perils in Computer, 56*(05), 116-121. https://doi.org/10.1109/MC.2023.3253292

Ng, D. T. K., Leung, J. K. L., Chu, S. K. W., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence, 2*, 100041. https://doi.org/10.1016/j.caeai.2021.100041

Ng, D. T. K., Leung, J. K. L., Su, J., Ng, R. C. W., & Chu, S. K. W. (2023). Teachers' AI digital competencies and twenty-first century skills in the post-pandemic world. *Educational technology research and development, 71*(1), 137-161. https://doi.org/10.1007/s11423-023-10203-6

Pearce, K., Alghowinem, S., & Breazeal, C. (2023, June). Build-a-Bot: Teaching Conversational AI Using a Transformer-Based Intent Recognition and Question Answering Architecture. *Proceedings of the AAAI Conference on Artificial Intelligence, 37*(13), 16025-16032. https://doi.org/10.1609/aaai.v37i13.26903

Pokrivčáková, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. *Journal of Language and Cultural Education*. https://doi.org/10.2478/jolace-2019-0025

Posner, T., & Fei-Fei, L. (2020). AI will change the world, so it's time to change AI. *Nature, 588*(7837), S118-S118.

https://doi.org/10.1038/d41586-020-03412-z

Punie, Y., & Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*, EUR 28775 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-73718-3 (print), 978-92-79-73494-6 (pdf), https://doi.org/10.2760/178382 (print),10.2760/159770 (online), JRC107466.

Qadir, Junaid. (2022). *Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education*. TechRxiv. Preprint. https://doi.org/10.36227/techrxiv.21789434.v1

Quinlan, T., Higgins, D., & Wolff, S. (2009). Evaluating the Construct-Coverage of the e-rater® Scoring Engine. Research Report. ETS RR-09-01. *Educational Testing Service*. https://doi.org/10.1002/j.2333-8504.2009.tb02158.x

Sari, E., & Han, T. (2021). Automated L2 Writing Performance Assessment: A Literature Review. *The Reading Matrix: An International Online Journal, 21*(2).

Sleator, L. (2023). *Almost half of Cambridge students admit they have used ChatGPT*. The Times. Retrieved from https://www.thetimes.co.uk/article/cambridge-university-students-chatgpt-ai-degree-2023-rnsv7mw7z

Smith, R. G., & Eckroth, J. (2017). Building AI applications: Yesterday, today, and tomorrow. *Ai Magazine, 38*(1), 6-22. https://doi.org/10.1609/aimag.v38i1.2709

Tai, T. Y., & Chen, H. H. J. (2021). The impact of immersive virtual reality on EFL learners' listening comprehension. *Journal of Educational Computing Research, 59*(7), 1272-1293. https://doi.org/10.1177/0735633121994291

Tang, Ko-Wai, W. (2018). Assessing information literacy skills of undergraduate freshmen: A Case study from Hong Kong. *International Journal of Media and Information Literacy, 3*(1), 11-17. https://doi.org/10.13187/ijmil.2018.1.11

Tewari, A., Sarguroh, N., Kingrani, P., Shetty, T., & Motwani, R. (2021, April). AI-based autonomous driving assistance system. In *2021 5th international conference on computing methodologies and communication (ICCMC)*, 1491-1498. IEEE. https://doi.org/10.1109/ICCMC51019.2021.9418403

Valtonen, T., Sointu, E., Kukkonen, J., Kontkanen, S., Lambert, M. C., & Mäkitalo-Siegl, K. (2017). TPACK updated to measure pre-service teachers' twenty-first century skills. *Australasian Journal of Educational Technology, 33*(3). https://doi.org/10.14742/ajet.3518

Vitartas, P., Heath, J., Midford, S., Ong, K. L., Alahakoon, D., & Sullivan-Mort, G. (2016). Applications of Automatic Writing Evaluation to Guide the Understanding of Learning and Teaching. *Ascilite, Adelaide, Australia*. https://doi.org/10.14742/apubs.2016.798

Yan, D. (2023). Impact of ChatGPT on learners in a L2 writing practicum: An exploratory investigation. *Education and Information Technologies*, 1-25. https://doi.org/10.1007/s10639-023-11742-4

Appendix

The following describes the items used in the AI Readiness for English Language Teachers survey.

Please rate your level of agreement with each statement below:

(1= Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree and 5= Strongly Agree)

Construct	Item
TK	1. I know how to interact with AI-based tools in daily life.
	2. I know how to execute some tasks with AI-based tools.
	3. I know how to initialize a task for AI-based technologies by text or speech.
	4. I have sufficient knowledge to use AI-based tools.
	5. I am familiar with AI-based tools and their technical capacities.
TPK	6. I can understand the pedagogical contribution of AI-based tools in the English classroom.
	7. I can evaluate the usefulness of feedback from AI-based tools for English teaching and learning.
	8. I can select AI-based tools for students to apply their knowledge and improve their English language skills, including both receptive and productive skills.
	9. I know how to use AI-based tools to monitor students' English language learning progress.
	10. I can interpret messages from AI-based tools to give real-time feedback.
	11. I can understand alerts (or notifications) from AI-based tools to scaffold students' learning.
	12. I have the knowledge to select AI-based tools to sustain students' motivation in English language learning.
TCK	13. I can use AI-based tools to search for educational material in English language learning and teaching.
	14. I am aware of various AI-based tools that are used by professionals in English language teaching.
	15. I can use AI-based tools to better understand the contents of English language teaching.
	16. I know how to utilize AI-based tools for English language teaching (e.g., e-rater, Duolingo, ChatGPT, etc.).
TPACK	17. I know how to use different AI-based tools for adaptive feedback in English language teaching.
	18. I know how to use different AI-based tools for personalized learning in English language teaching and learning.
	19. I know how to use different AI-based tools for real-time feedback in English language teaching and learning.
	20. I can teach the English language using AI-based tools with diverse teaching strategies.
	21. I can teach English lessons that appropriately combine my teaching content, AI-based tools and teaching strategies.
	22. I can take a leadership role among my colleagues in the integration of AI-based tools into our English classrooms.
	23. I can select various AI-based tools to monitor students' learning in my teaching process.
Information Literacy	24. I am confident in identifying the most appropriate sources of information for a research question or task.
	25. I feel comfortable using advanced search techniques to locate relevant information in online databases and other sources.
	26. I can evaluate the reliability and credibility of information sources and distinguish between fact and opinion.
	31. I understand the importance of citing sources properly and avoiding plagiarism and can do so effectively.
	27. I can create and organize information from multiple sources and present it in a clear and coherent manner.
	28. I can critically analyze information to identify biases, assumptions and potential limitations.
	29. I am familiar with various types of information formats, including multimedia and digital resources.
	30. I can use technology tools and applications effectively to access, evaluate and communicate information.
	31. I have a good understanding of ethical and legal issues related to the use of information, including privacy and intellectual property.
	32. I am committed to lifelong learning and professional development, and actively seek out new information and skills to enhance my knowledge.